A Work Project, presented as part of the requirements for the Award of a Masters Degree in Management from the Faculdade de Economia da Universidade Nova de Lisboa.

The Digital Product Development Process: Developing the Nova Canteen App

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A Project carried out on the *Digital Business* course, with the supervision of:
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Abstract

This paper analyses the product development process with the real-life example of the development process of the "Nova Canteen App" as part of this year's Pulse Challenge. Firstly, an introduction of the theoretical background with a literature review of the traditional and digital product development process is examined and presented to then reflect on the main stages of the "Nova Canteen" project. The key findings result in learnings when introducing theory into practice. Based on the experiences from the Nova Canteen project, it is concluded that especially project management, project organization and the stage of problem validation are crucial steps that are significant when developing a product, or in this case, a mobile application.

Key Words: *Product Development, Digital Product Development, Digital Product Design, Project Management*

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Abbreviations and Acronyms

Nova SBE	Nova School of Business & Economics
COVID	Corona Virus Infection Disease 2019
MVP	Minimum Viable Product
FTE	Full Time Employee
GDG	Google Developer Group
NTC	Nova Tech Club

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1. Introduction

In 2018, top companies like Amazon, Merck, or Sanofi spent up to 25.4% of their revenues on Research and Development (R&D). The total R&D spending by the top twenty companies was $214.5 billion with an expected rising trend in the upcoming years (Jaruzelski, Chwalik, and Goehle 2018). These numbers reflect the enormous importance that companies see in product development as being the major force of innovation. In today's digitalized world, market trends are evolving quicker than ever before. Product life-cycles have become shorter, while the diversity and speed of market trends have significantly increased (Yan, Hongke, Li, and Guangyu 2006). To meet the resulting ever-changing consumer preferences while also ensuring profitability despite the increased complexity is a challenge, companies of nearly all industries have to deal with. Product development has thus become a critical leverage effect on deciding the overall success of a product or company.

As a result of the increasing importance of product development, these statistics show the necessity of a standardization and systematization of the development process to minimize the risks for companies while simultaneously optimizing the resulting products and services. However, these standardizations in theory can bear problems when introduced into practice. In this paper, the product development process in theory and practice is thus further analysed.

This work project was developed in close cooperation with this year's *Pulse Challenge* at the Nova School of Business and Economics (Nova SBE). After presenting the theoretical background and the evolved main steps and frameworks of the digital product development process, the Pulse Challenge project "Nova Canteen App", which won second place in this year's competition, will be used to examine the practical side of this process. For this, further insights on the execution side are shared and examined from the point of view of the project leader. Conclusively, the main reflections, challenges and learnings of the execution will be examined while also reviewing the theoretical approach.

2. Research Methodology

The research question addressed in this work project is the following: *Which aspects are important to consider when developing a useful*[1] *mobile application?*

A central role of this work project is the development process of the mobile application "Nova Canteen App". The research methodology is thus following an inductive approach so that potentials can be derived from the presented analysis and discussion. Furthermore, qualitative data is used for the analysis of the research question representing a retrospective approach to gathering rich insights for a full understanding of the subject matter. During the development process, however, a mixed data approach was used. Interviews, an online survey, a benchmark analysis, a literature review, and a time measurement were all used to gather the needed data for the development process and are shortly also presented in this project work.

3. An Introduction to Product Design & Product Development

A product passes various phases during its full product lifecycle (Ponn and Lindemann 2011). To better understand the central topics of this work project, an introducing definition must be presented. However, throughout the past decades, product development and product design were analyzed by various academic disciplines resulting in corresponding diverse perspectives and approaches for the overall process.

In this paper, *Product Development* is understood as the entire set of activities needed to transform a product concept into a market-ready product or service (Browning and Ramasesh 2007, Otto and Wood 2001). Product development aims to create a 'recipe' for producing a product (Reinertsen 1999, 48). This process thus covers various steps in which a company designs and conceptualizes a product until its commercialization, ranging from the initial product idea to the final development of manufacturing and distribution plans.

[1] *useful* is understood as „able to be used for a practical purpose or in several ways "

The *Product Design Process* covers a set of technical activities within the Product Development Process that are introduced to better understand and meet the marketing and business needs of a company and the accompanying product (Otto and Wood 2001). Within these tasks, the product vision is further explored and translated into more technical specifications like the user journey, a style guide, and prototypes (Costa and Franco 2019). The Product Design Process thus focuses more on the product specification and business visions, while it usually does not cover financial management and marketing development tasks (Otto and Wood 2001).

There are various reasons why product development and product design has become a large field of interest for practitioners and researchers within the past 20 years. Especially in times of digitalization with a shortened product life-cycle due to the rapid development of science and technology since the 1990s, manufacturers, and suppliers are forced to rapidly develop high-quality products to meet the increasing market demands and to enhance their competitiveness (Yan, Hongke, Li, and Guangyu 2006; Browning and Ramasesh 2007). With these new conditions, managerial challenges increased significantly which resulted in a new need for coordination and decision support functionalities that product development standards could provide (Browning and Ramasesh 2007). Further, product development is seen as one of the only potentials of a company or organization to introduce innovation by diversifying, adapting, or reinventing the firm which makes it an essential process for success, survival, and renewal (Brown and Eisenhardt 1995). With the underlying rationale that most macroeconomic factors and forces are not directly controllable by individual market players, product development becomes the only proactive opportunity for companies' competitive success (Brown and Eisenhardt 1995). Product development is thus seen as critical for companies as it can decide for success or failure of a product and thus of the company itself.

The new attention and significance of product development led to an equally significant increase in research. Within the past decades, an extensive body of literature was developed in a variety of disciplines like engineering, operations management, project management, and information systems. One of the most prominent topics within this research field remains the product development *process*. Overall, a process is "an organized group of related tasks that work together to create a result of value" (Hammer 2001, 1). The historical evolution until today's understanding of the product development process was mainly shaped by two different research disciplines: the *engineering research on development methodology* and the *economic research on the management of the product development process* (Albers 2010). With these research focus points, various definitions of the inherent activities of the product development process resulted. The overall research area has thus become rather fragmented (Brown and Eisenhardt 1995, Otto and Wood 2001). An additional reason for this diversity is that the range and depths of the phases and individual steps can, and some even argue, *must* vary from sector to sector and from company to company as different factors influence these environments (Brown and Eisenhardt 1995, Browning and Ramasesh 2007). One of the biggest differentiators is as well the type of product with nowadays for example largely different concepts of a development process for physical or digital products (Eigner and Stelzer 2009).

Already in early research, the area of product development has been closely linked to the innovation research area (e.g. Nelson and Winter 1977, Urabe, Child and Kagono 1988, Adler 1989). Still, until now product development and especially the early stages of the process with the product design activities is seen as part of a firm's R&D process. Initially, this research field was divided into two broad areas: an *economics-oriented* research area, focusing on macro-level innovation management across countries and sectors, and an *organization-oriented* research area, focusing on the microlevel processes how specific products are developed (Adler 1998). Product development was seen as an organization-oriented field, mostly focusing on internal

processes and structures which endorse the creativity process (Brown and Eisenhardt 1995). While research and academia used to divide between both areas, today's research argues that theories and findings in both areas are interdependent in practice and should thus be strongly linked (Ehrlenspiel 2007). As a result, most models especially in Product Design activities for or within a product development process nowadays show both, internal and external analysis steps (Browning and Ramasesh 2007, Costa and Franco 2019).

Despite the fragmentation of the research area, high-level product development models have been developed to offer a minimum level of standardization. For this, three widely accepted propositions about product development were identified by research. Firstly, even though the concept of product development shows a certain ambiguity due to the immense diversity of research fields, the process has a repeatable and consistent structure (e.g. Austin, Baldwin, Li and Waskett 2000; Tatikonda and Rosenthal 2000). Even though it aims towards a unique and innovative outcome, the overall process follows similar approaches. Secondly, product development is often linked to tasks and activities from project management which offers a highly structured approach (Browning and Ramasesh 2007; Meredith, Shaefer and Mantel 2017). Lastly, with the help of process models, processes can be engineered and facilitated no matter how complex structures have become (Negele, Fricke, and Igenbergs 1997; Browning 2002). Especially for designers, these models might have become crucial to sketch processes as the complexity increases. With these underlying propositions, various models in product development were designed to facilitate and further explore the management and development of innovation.

On a high-level approach, the product development process can be parted into three main phases: *understanding an opportunity*, *developing a concept,* and *implementing a concept* (Otto and Wood 2001). In the first phase, an intense market opportunity analysis should be conducted to

identify and also decide whether a product development process needs to be introduced. The second stage includes all activities needed to decide what the product or service will be. During the final stage, the concept of the product or service is finalized so that production could start. The concept of the phases however does not imply that each activity has to run consecutively but offers more of an overall categorization of the process in itself (Otto and Wood 2001). This high-level approach was mainly introduced in early product development models which focused dominantly on manufacturing and engineering areas (Snelson and Hart 1991; Eigner and Stelzer 2009). When breaking it down to more detailed process models, there have been various popular approaches from research and practice. One of the more detailed processes which were derived from the three phases approach is the *Three Cycle Model.* It was initially introduced for physical products but is today partially used in digital product development areas as well (Ponn and Lindemann 2011). The model can be understood as a network of different cycles that interact with each other (Gausemeier 2006). Following the three phases approach, it divides the product development process into three main stages: strategic product planning, product development, and production system development, which individually are run in loops (Gausemeier 2006). The concrete phases per cycle depend on internal and external factors just as the sector, the market factors, the organization, the internal communication lines, and the hierarchy structure, as well as the idealized product (Gausemeier 2006).

More recent research papers suggest a three to four staged process divided into *Research*, *Ideation, Execution, and Technical Assessment* (Costa and Franco 2019). Despite smaller differences, the overall process of initially ideating and researching a problem to then creating and testing a possible solution is still seen as viable for most companies and organizations resulting thus in similar steps within different process models.

As there are various product development models in the market, some researchers propose a more structural approach by categorization. A widely accepted study by Brown and Eisenhard

(Brown and Eisenhardt 1995) analysed the at the time pioneering studies in product development and divided the different approaches into three research streams: the *rational plan*, the *communication web*, and the *disciplined problem-solving*. Each research stream was constructed from a different objective in product development and subsequently in innovation. They found out that each stream built a different model of factors affecting product development success. The *rational plan* stream focuses on the financial success of the product and thus constructs a product development model that is characterized by time, resource, and money efficiency. The objective of the *communication web* stream focuses on the perceptual success of the new product and thus constructs a model that is characterized by a strong focus on internal and external communication lines. The *disciplined problem-solving* stream on the other hand focuses on operational success. Next to a creativity and a critical thinking approach, also speed and agility are characteristics of a representative product development model. Also until now, product development models are often assigned to one of the categories by Brown and Eisenhard (1995) (Tidd and Bessant 2020, Massa, Tucci and Afuah 2016).

The literature review of product development and product design shows that a large body of research can be discovered. There is not one general viable solution or model that has been agreed on in research, however, a widely accepted high-level concept seems to be in place. Further, it seems as if the resulting diversity is benefiting the increasingly growing complexity of the practice field. The product development process seems to change with its requirements. As soon as the product or the environment changes, the process seems to be adjusted as well. One of the biggest disruptors of the past decades can be identified as *digitalization*. The digital product development process must therefore be further examined to understand how the digital development process may have changed.

4. How Digitalization has changed the Product Development Process

Today, four industries, namely software & internet, auto, healthcare, and computing & electronics account for more than 97% of the top 20's R&D spending (Jaruzelski, Chwalik, and Goehle 2018). The increasing intelligence of today's systems and products also increases the needed requirements of the product development processes resulting in a new level of complexity. Traditional methods in product development built from a market landscape dominated by manufacturing suppliers are seen to not fully meet the current more digitized requirements of the market and its demand (Yan, Hongke, Li, and Guangyu 2006). This new market landscape led to a reflection of the dominating process models, assumptions, and main differentiators in four key areas:

4.1 The Process in Change: Manufacturing vs. Software Development

Today, manufacturing is often enhanced if not even fully replaced by more digital processes coming from software development (Eigner and Stelzer 2009). Software development has changed most of today's industries and the accompanying digitalization is still on its rise also changing the production landscape. It allowed one major change in the market: A software product or project is intangible, resulting in a partial or full lack of physical components (Bergsjö 2009). This also has its consequences in the product development process. Despite the previously described methods and approaches coming from a strong physical and product-related perspective, software development has evolved from a different field with different focus areas and methods (Somerville 2007).

While in the manufacturing sector, the product development process can vary depending on the production, market, or industry, the process is more or less standardized to minimize risks (Eigner and Stelzer 2009). Most models follow a sequential variation of tasks usually constructed around the requirements of the mechanical production process. In the course of the process, a product is chosen from a variety of concepts using a set of criteria that usually focuses

on production feasibility and efficiency as well as customer needs (Eigner and Stelzer 2009). In an exemplary model by Ulrich and Eppinger (2008), the model is split into six strictly standardized phases. The key phase of a manufacturing product development process seems to be the production phase. It will be standardized and thus require certain risk tests beforehand as the production marks also the end of the traditional, physical product development process (Ulrich and Eppinger 2008).

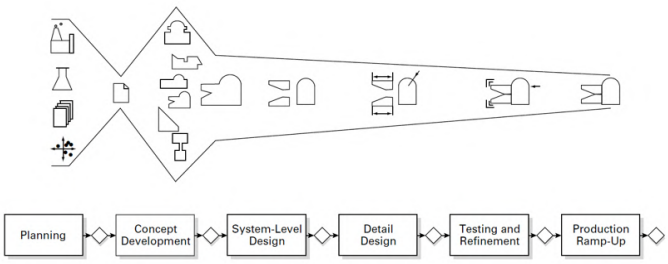

Figure 1 The generic Product Development Process according to Ulrich and Eppinger (2008)

Software projects on the other hand can be constructed differently. In this sector, no production or manufacturing is usually needed, so that the process depends more on the intellectual resources (Nambisan, Lyytinen, Majchrzak, and Song 2017). Further, the digital approach shows a higher customer-centricity focusing more strongly on needs and market requirements than on production needs (Nambisan, Lyytinen, Majchrzak, and Song 2017). Advances in software development are more rapid than in other industries leading to an ever-improving and ever-changing field of methods and processes (Yan, Hongke, Li, and Guangyu 2006). Each software project therefore can be constructed differently, so that most projects are rather unique. This leaves only very little room for standardization. A rather generic way of visualizing a software project was made with the Boehm spiral model (Boehm 1988, Somerville, 2008). The overall process is divided into four areas which are repeated in an iterative loop. A software project can be improved at any time as it is not dependent on or limited by a production or manufacturing sequence (Boehm 1988, Browning and Ramasesh 2007, Bergsjö 2009). When combining this with the

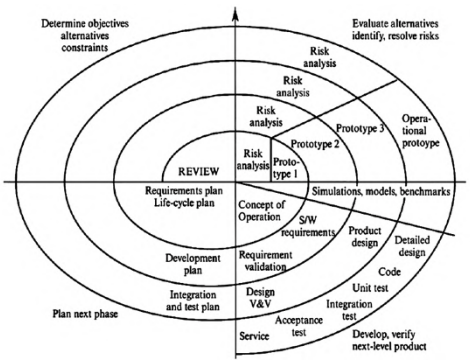

Figure 2 The Boehm Spiral Model for Software Development (1988)

previously presented categorization of product development processes by Brown and Eisenhardt (1995), digital product development processes seem to thus have a stronger focus on *disciplined problem solving* than on *rational plan* or *communication web* ideas. While the initial product is constructed to solve a specific problem, the development stages are also focused on the theme of "problem solving" for example with reviewing stages constructed around bug fixing tasks (Katzir 2018, Somerville 2007). As problems are hard to predict, there are less standardized processes in the digital product development process (Bergsjö 2009). The objective is thus to be as agile as possible to quickly react to upcoming development bugs or market changes (Bergsjö 2009). In comparison, the digital product development process shows substantial differences from the traditional product development process based on manufacturing productions.

4.2 Project Management: Perfection vs. Agility

Project management plays a critical role in any product development process. However, the structure, tasks, and functions have seen a smaller shift with the rise of digitalization (Meredith, Shafer, and Mantel 2017). In manufacturing, *perfection* plays a highly important role. A possible damaged or non-functioning production release cannot be adjusted when it has left the production hall (Bergsjö 2009). Design or production errors can thus bear high risks. A production error or functionality problem that is discovered after a product launch is nearly impossible to solve so that multiple tests have to be run to minimize this risk (Nambisan, Lyytinen, Majchrzak, and Song 2017). Constant quality checks are thus essential for the product development process. Therefore, a *waterfall* or *stage gate* project structure is often used to handle the project management (Otto and Wood 2001, Browning and Ramasesh 2007). Both approaches are structured with constant review and sign-off process steps to minimize potential problems and risks (Otto and Wood 2001).

In a digital landscape, the waterfall approach can bear risks (Meredith, Shafer, and Mantel 2017, Bergsjö 2009). Perfection are often less important than agility (Bergsjö 2009, Katzir 2018).

Digital products allow a constant improvement cycle so that the time-to-market becomes more crucial. *Scrum* and *Kanban* are two of the most frequently used project management approaches in digital product development as it offers a more spread knowledge transfer and a more thoroughly supported brainstorming tool (Bergsjö 2009, Katzir 2018). While the overall product development process between digital and physical products vary, also their project management differs significantly. The core objective and rationales construct different tasks, building a gap between perfection and agility.

4.3 Performance Measurement: Disciplined Problem Solving vs. Rational Plan

For any successful project, performance measurement is crucial to minimize risks, detect problems, and increase motivation. Key Performance Indicators (KPIs) are used to develop a measurement framework that helps to assure quality and success and can be used as an early-warning system for potential risks (Parmenter 2015). Risks can thus be used as the main orientation for the selection of viable KPIs.

For traditional manufacturing product development processes, the production represents the highest risk as it binds the highest cost and offers low agility and flexibility (Katzir 2018). According to the theory of Brown and Eisenhardt (1995), most manufacturing processes would thus be categorized as *rational plan* processes. These processes rate their performance usually with financial indicators with for example profits, revenues, and market shares (Brown and Eisenhardt 1995). As the manufacturing is often more cost intensive, financials play a crucial role and should thus also be displayed in the internal KPIs (Katzir 2018). Usually, a digital product development process would be classified according to Brown and Eisenhardt (1995) as a more *disciplined problem solving* instead of a rational plan process. Time to market is more critical than financial success so that different KPIs would be defined.

4.4 Design: A New Era of Design

A McKinsey study showed that design is essential for the success of a company as it is directly linked to financial performance (Sheppard et al. 2018). In this case study of more than 300 companies over a timeframe of five years, it was found out that design can improve the overall performance of a company in most sectors, whether it is a service or a physical or digital product. With the vast offerings in the markets, only the best ones stand out. Especially with digitalization and the ever-increasing consumer expectations coming for example from online review functions and new globalized access to information and goods, the direct appeal to the consumer increases in its importance (Sheppard et al. 2018, Katzir 2018). Companies are forced to not only have high efficiency and effectiveness but also a high level of design and aesthetics.

The literature review of the digital product development process shows that there are different approaches and understandings between the digital and the traditional product development process. To understand which implications this might have, a practical example should be used to review and examine the overall process in general.

5. A Process in Practice: The Development of the Nova Canteen App

With the underlying theoretical background of the product development process, the formal concept can be used to review a real-life product development process. This work project was developed in close cooperation with this year's Pulse Challenge. In the next step, the development process of the resulting mobile application *Nova Canteen* will be further analysed based on the presented theoretical background of the product development process.

In late 2019, the *Pulse Challenge* was first introduced by Nova SBE's Digital Experience Lab (see Appendix 1). The newly developed challenge aimed at assessing what opportunities technology can have on small ecosystems like university campuses, addressing the topic of the

University of the Future. For this, the Pulse Challenge was created to use the on-campus knowledge resources coming from students to develop technological solutions that improve the quality of Nova's campus life. Simultaneously, the challenge was also designed to offer a unique practical learning experience apart from the curriculum. Students were encouraged to use their critical minds and creativity to participate with their individual ideas to solve on-campus problems. The challenge ran over a timeframe of four months and in three consecutive stages: ideation, development, and demonstration. In the final stage, all remaining teams had the opportunity to pitch their solutions to the entire Nova community on an online platform so that a community voting process would help to evaluate the winning project. In total, eight teams participated in the initial stage, while five were introduced as finalists in the final stage.

This thesis focuses on the development of the Pulse Challenge project "Nova Canteen App", which succeeded in second place in the competition. With the Nova Canteen App, long queues and waiting times at Nova's food court are tackled by introducing an intelligent food pre-ordering system on-campus. With a mobile application, students can easily pre-order their lunch, dinner, or snack beforehand so that restaurants can more efficiently plan their food preparations while students can use their time more productively. The idea and overall project were initiated and also further developed by a small group of Bachelor and Master students of the Nova Tech Club (NTC) and with technical guidance from the Google Developer Group (GDG). The internal development stages were arranged following the three Pulse Challenge Stages and their deadlines, resulting in a four-staged process in alignment with Costa and Franco's (2019) development process: ***Research, Ideation, Execution, and Technical Assessment.*** In the following sections, each step of the product development process of the Nova Canteen App is first described, to then further reflect insights with the presented theoretical background and in the end to derive the key learnings of the team and potential implications for the general product development process.

5.1 Research: Problem Identification and Validation

The initial idea for the Nova Canteen App resulted from a brainstorming session within the NTC project team in late 2019 and was initially meant to become a topic of research for a coding workshop session with the corporate partner, GDG. For the scope of the planned workshops, an application idea was needed to then start programming sessions about the topic of frontend development. For this, on-campus problems were presented and discussed to identify potential technological opportunities or solutions.

The biggest pain point identified were the long waiting times and queues between classes and especially during lunch and dinner breaks. The time spent in queues led to an increased level of unproductivity which especially during exam periods became highly stressful. As a consequence, some students reported to choose faster and more unhealthy alternatives or stated to even skip food to not interfere with upcoming classes, group works, or study sessions. The feedback gathered from the small number of students within the team showed a strong and coherent view of the problem. However, a more concrete problem investigation was needed to validate the scope and scale of the problem. For this, the following diverse quantitative and qualitative validation schemes were conducted to gather further insights into the problem: interviews, an online survey, and a time measurement of the queueing time.

An online survey with close to 150 participants from Master's, Bachelor's, and Ph.D. levels gave first indications of the scope of the problem as well as the overall food court behaviour of students (see Appendix 2). According to the results, the typical student is at least five times per week at the food court actively buying a meal or snack (see Appendix 3). The analysis showed that more than half of the students "usually" if not even "always" buy their food on campus instead of preparing it at home. While only two (1.6%) of all responses criticized the quality of the food, 65% of the students see the long waiting times or queues as the main pain point in the food court. 43% even said that due to this, they had changed their usual food behaviour to either

bring prepared food from home or to go for a quick and perhaps even less nutritious alternative instead. A first problem validation seemed to be successful.

In a next step, the team measured the actual waiting time in queues on different occasions with a result of a maximum waiting time of up to twenty-five minutes, which was considered as *long* or *too long*.

To achieve the highest level of authenticity and honesty, eleven semi-structured and in-person interviews were conducted to better understand the actual characteristics of the problem and to give interviewees more room to share their thoughts, and to build a dialogue (see Appendix 4). The vast majority also in these interviews stated that long waiting times and crowdedness during breaks had led to problems in the past. The result of the interview indicated also that different needs led to different forms of problems with the food court organization. With the presented results, the team thus decided to develop personas with clustered characteristics and pain points to better understand the problem (see Appendix 5). Three different personas were thus designed differentiated by their food behaviour, their average money spent on food, and their main pain points.

The first persona the "Food Prepper" was characterized by bringing prepared meals to campus while also buying snacks in the food court. This persona is annoyed by the crowdedness coming from long waiting lines and is thus often not considering the on-campus restaurants or bistros for lunch or snacks. This persona is expected to be relatively price sensitive. The survey and interviews further indicated that this persona would most likely be Portuguese, in their Bachelor's and living at their parents' house.

The second persona was named the "Social Eater" and is mainly characterized by planning lunch, dinner, and snack breaks according to their friends. This persona does not bring prepared food but buys at least one meal on campus. This persona thus spends the highest amount of money for food on campus while still being relatively price sensitive and nutrition-conscious.

Results from the problem investigation indicated that this persona would be an international student, living on his own or in a shared apartment.

The third persona, the “Foodie”, is someone enjoying food more than hating standing in line. While the frustration of the queues is as high as for the *Social Eater*, this persona still values the food quality and the options given very much but sees that due to the hectic during lunch breaks the overall food quality has decreased. More organization as well as transparency and customization would improve his or her customer experience. This persona is expected to be less price-sensitive than the others.

The presented profiles were sketched based on the results of the survey and the interviews to better understand the needs and pain points linked to the problem. For a first indication, the given insights allowed for a better design of an appropriate first solution. It was however discussed that these steps of the problem validation have to be constantly reassessed to fully understand also the development of the problem given for example the expansion of the food court with Pingo Doce or the impact of COVID-19.

Further, the presented problem validation steps only covered one half of the stakeholder groups. Restaurants and bistros from the food court are directly involved and could also be experiencing the effects of the same or similar problem. Additionally, a potential solution could take over an intermediary role between the user and the restaurants. For the project team, it was thus crucial to further get insights from the restaurants. Despite best efforts, however, this process had to be delayed due to the COVID-crisis which led to shutting down first the food court and then the whole campus. As a first indication, however, the team decided to reach out to similar projects to use their insights representatively. The project team was very happy to receive a response from Mrs. Alexcis Mendoza, Marketing Manager for UH Dining at the University of Houston, Texas. In 2017, the university successfully implemented an on-campus mobile ordering app called “boost” (see Appendix 6). Mrs. Mendoza briefly explained that the identified problem is

closely related to the one observed on their campus. Their results showed that nearly all restaurants saw an added value in the app and joined the platform very quickly. Due to the still ongoing COVID-crisis, the team is still waiting on further insights from Nova's restaurants and bistros.

This first stage of the process resulted in having identified and successfully validated a problem which can in the next step be solved with a first MVP solution. To conclude, the first stages of this process were dominated by focusing on the core problem. This however led to challenges on its own. As presented, the initial idea of the Nova Canteen App was derived from a coding workshop in late 2019. In this meeting, the problem was shortly discussed to then focus mainly on a solution which can then be programmed. During this first meeting, a more concrete solution was therefore already designed in everyone's head. When then deciding to further develop the project, this first stage of problem identification and validation became more challenging, as many first had to take one step back to reassess the problem without actually thinking about a solution.

5.2 Ideation: Design & Early Development

With the new input, a more specified solution could be further idealized. The initial idea of the Nova Canteen App was seen as still viable and highly valuable, as it offered a possible solution to all stakeholders as well as the sketched persona groups.

The Nova Canteen App was thus further designed as an intermediary between those offering food and those ordering food. With a mobile application, food could easily be pre-ordered to ensure an easy and on-time pick-up while also enhancing the predictability and thus efficiency of the restaurants. The ordering customer journey would be similar to those of comparable food ordering applications, like Uber Eats, Foodora, or Glovo. Users would sign up, create a profile, and could then pick their meals from the menu displayed in the application. While in a long run, the app would also manage the payment process and would thus allow a full ordering process,

the application would in a first step be limited to a queueing feature without payment functionalities as complex administrative tasks would be involved otherwise. End users would thus set a pick-up time frame after choosing the meal and would pay directly at the restaurant or bistro after a notification for the pick-up was sent.

The interface for restaurants is focused on offering an order management system with an overview of all incoming orders and their current status. This interface would be displayed as an application on a tablet or laptop with comparably fewer features and an overall lower level of complexity. The focus of this application is dominated by an easy handling, by straight-forward functionalities, and a high level of automation. To keep it as simple as possible, one main screen would display all relevant information per order. Users can initially move each order manually from process step to process step while more automation in the form of predictive analysis or scans could be added at a later stage as well. For the MVP, the system is not further connected to the initial restaurant backend system so that payment and billing processes are handled through the existing management systems of the restaurant.

After having further specified the functionalities and features of the Nova Canteen App, an initial Design and Development process started. For this, the project team was split into three groups: *Design*, *Coding*, and *Pitching*.

The Design Team developed a design prototype according to the customer journey in Adobe XD (see Appendix 7). As the Nova Canteen App would serve as an intermediary between the restaurants and the students or university staff, two user interfaces had to be designed. While the complexity of the restaurant interface, consisting of one main screen, was relatively low, the complexity of the user interface for the mobile application on the other hand was comparably high. The first set of wireframes including more specifications like colour, font, and license-free images was developed with the insights from the first survey and interview results. The app was

constructed following the model of other already existing pre-ordering apps to ensure a convenient and easy handling (see Appendix 8). The app can be used to either pre-order meals in advance for the next day or to pre-order immediately. For this, dynamic information regarding the current waiting time is displayed. Based on historical data as well as a smart backend system on the restaurant side, the app can calculate dynamically the approximate waiting time and potential queue position.

The restaurant interface was designed to offer an easy handling with three main functionalities: accepting/refusing an incoming order, setting the order to "ready to pick-up" manually or automatically, and, if needed, contacting the customer (see Appendix 9). With this, users can easily track the orders as well as their operations.

The resulting digital prototype was tested internally with members of the Nova Tech Club and partially also with participants of the survey and interviews. Due to the COVID19- pandemic, however, this testing was partially held online which led to less valuable results. It was thus decided to start developing in parallel already.

The Coding Team focused in the first step on the front-end development of the proposed design prototype. In this team, a close collaboration with Pavlo Figol, a GDG software developer specialized in app development offered intense technical support and held different workshops for each process step. With his input, it was decided to work according to the web application framework *angular* and use the online platform NativeScript to build the app as a native iOS and Android mobile application (see Appendix 10). While some of the coding team members had already worked with front-end development, the majority was new to the topic so that the team was further divided into pairs to allocate the resources more efficiently. To ensure and improve the cooperation between the teams, weekly or bi-weekly meetings were introduced. The resulting screens coded in HTML and CSS were presented in group meetings to then gather feedback and to discuss the next steps. It was planned to start with backend development steps after finishing the frontend development tasks. As fewer members of the team were familiar

with this part of software development, this process part became highly dependent on the technical support provided by Pavlo Figol. Due to the COVID-19 crisis and resulting challenges especially in communication, the development process further started to show possible delays and insufficiencies.

It was however the Pitching team that suffered mainly from the new conditions introduced by the lockdown. The team initially was formed to intensify and concentrate on the stakeholder management efforts that were introduced by the project. Members of this team would more concretely communicate new steps and features of the Nova Canteen App with the involved restaurants, bistro as well as Nova staff members and plan the implementation and organization of the demonstration during the final of the Pulse Challenge. The COVID-restrictions however complicated most communication approaches.

Overall, this project phase demanded the highest effort from all project team members. Everyone had to actively participate in each project step and had to take over intense workloads to finish their sprint deliverables so that the Pulse Challenge timeline could be met.

5.3 Execution: A Business Plan

To fully assess the value and scope of the project to all stakeholders, a high-level business plan using the business model canvas and project plan was developed to point out the main potentials as well as key cost drivers of the project for the Nova SBE (see Appendix 11).

The project showed that the university has enough resources to further focus on implementing its innovation in-house. The knowledge and innovation base from students can be further used as also financial benefits would result. The project team in representation of the Nova Tech Club proposed to further take over the development of the Nova Canteen App while for an increased time efficiency it was also recommended to introduce the support from external technical supporters as well. Especially for app maintenance and customer support, an additional resource

would be needed. For the long-term product idea in which also a payment functionality is included, potential legal checks have to be administered.

The objective for Nova would be to improve the campus experience while not primarily making significant profits. For the restaurants, the new channel offers new business opportunities. The result could be the need for fewer FTEs and a more efficiently distributed food and retail chain which will positively influence their cash flows. Costs for the development as well as the ongoing maintenance could therefore be split between Nova and the restaurants. Also, hardware devices for the restaurants would be needed to ensure a well-functioning interface to the system.

5.4 Technical Assessment: Demonstration and Testing

The aim of the Nova Canteen project and the participation in the Pulse Project was to develop an MVP for the final stage of the Pulse Challenge. During this demonstration, a full pre-ordering process with all involved stakeholders and user interfaces would be tested. Due to the global COVID-19 crisis and the resulting shutdown of the university campus, also the Pulse Challenge had to switch to an online presentation format. A demonstration therefore did not take place. Instead, a white paper and a recorded presentation were published to the Nova Community (see Appendix 12 & 13). Further, parts of the development process had to be partially delayed as also the technical support in the backend development from Pavlo Figol was due to COVID missing information as well as the needed physical testing stage. The MVP was thus postponed to a later stage.

To this date, the Nova Canteen project is still further on hold as due to the COVID-pandemic, the overall need for a food pre-ordering application is at least minimized. While the on-campus restaurants and bistros were partially closed during this semester, students were also encouraged to spend less time on campus. In this situation, the identified core problem alongside to the general campus life is missing. The team is though certain that the process can soon continue.

Main Learnings & Discussion

The project of the Nova Canteen App was indeed a unique learning experience for everyone in the team. Especially for me, as the project leader, there were many learnings that I was able to derive from the many challenges along the way. In this discussion section, I will filter and discuss the most important and valuable insights from theory and practice.

The literature review showed that the product development process is a flexible yet complex process. There is an extensive research body with various theoretical recommendations and insights. While one could argue that their impact and influence in practice are limited due to the pure theoretical nature, the experience from the Nova Canteen App showed me that it can be highly valuable to have an underlying structure. Especially as the project leader, it very much helped to have a high-level orientation of the current status and upcoming tasks. From my experience, this led to increased efficiency as everyone knew the main process steps and therefore fully understood the value of each task, while it also helped me assuring and checking a certain level of quality.

There are various models that can give structure and guidance but the real-life experience from the Nova Canteen App showed us that our process was very reactive and more circular. Several initial assumptions were reviewed various times and new ideas were shaping the final product still in the very last stage. The Boehm Spiral or Three Cycle Model as presented in the first part of this paper incorporate this circular and less progressive approach very well. This coherence could be due to the digital focus of the Nova Canteen App which allowed us to go a step back at any time during the process. These models and frameworks can be a great help during the complexity of the project. My learning was thus, that one should use the available concepts to improve the overall efficiency of the project.

Further, our process also showed how important an internal and external analysis is for product development. Without the external experiences and inputs, different functionalities might have resulted. Our internal capabilities on the other hand were directly linked to the feasibility and operability of these features. From my experience, internal and external analysis steps are thus essential to provide a thorough understanding and thus a more suitable product or solution in the end.

With the help of an underlying project organization, we quickly also introduced more structures on a day-to-day basis involving project management. For us, not only for the Pulse Challenge deadlines, agility and flexibility were more important than perfection. The initial aim was first to develop an MVP and to then start adding or altering features after the first release. For this, we chose a sprint-like project management which is closely related to a Scrum and Kanban structure. However, there were various waterfall principles especially in design and coding tasks, so that a variation was used. My learning was that project management can be a combination of all needed structures. It must however reflect and fulfil the needs of the team.

As the project leader as well as the project's design lead, my biggest challenge was the project management concerning people's management. Teamwork in itself is indeed actual work while *leading* a team's work has even bigger dimensions. I underestimated the needed resources for the tasks of administration, stakeholder management, and leadership which may seem absurd since I am studying Management. As the project was voluntary, the willingness to invest time and knowledge differed largely in our team. As soon as COVID-19 complicated the further development of our project, the general motivation was close to a low. From time to time, I saw myself more as a motivational coach than an actual leader. I would assume that this experience differs when it is in an actual practical and stricter environment. My main learning was that one can have the best organization, project management, vision and idea – but if the needed team

resources do not work properly, the whole project is at stake. Teamwork is crucial but can also become a liability.

This insight leads me to one of the obvious but personal biggest learnings: business and management are social sciences – it is always about human interaction. While internally, the coordination of team members is crucial for the process, the overall idea is only valid if it is also accepted by potentials customers or users. The very first phase of problem or opportunity identification and validation thus becomes the essential baseline for all product development processes. This entrepreneurial approach is however more complicated as imagined as this phase is about the problem and not the solution. To avoid bias and ensure neutrality, it is important to first fully understand the problem before sketching a solution. In our case, we started the other way around which resulted in partial bias. I, therefore, decided to use new members of the NTC who were not involved in the project beforehand to help in researching the problem. My main learning is thus to focus on problem-solving instead of solution-building approaches.

6. Conclusion

Innovation remains the biggest competitive differentiator in the market. As the pace of innovation has significantly increased, product development has become more crucial and challenging for companies of various backgrounds. In this work, the real-life product development process of the Nova Canteen App was used to thoroughly examine the key process steps of developing innovation. The literature review showed that the product development process can be highly complex and even gain in complexity with the still ongoing rise of digitalization.

The presented analysis of the process aimed at answering the initial research question: *Which aspects are important to consider when developing a useful*[2] *mobile application?*

[2] *useful* is understood as „able to be used for a practical purpose or in several ways“

From the personal experiences described and analysed in this work, five key learnings from the point of view of a project leader were presented: (1) With the variety and volume of research in product development, there is a large diversity of product development process models in theory. However, each product development process in practice is different. Nevertheless, this does not mean, that one should not use a theoretical framework. Quite the contrary, this paper would strongly recommend using a model but to see it as a general guidance and support framework. (2) A thorough understanding of the problem and opportunity demands an internal and an external analysis. (3) The accompanying project management is crucial while the choice of method should as well be seen as rather flexible. Depending on the project and product type, waterfall or Kanban or even a combination could be most appropriate. (4) Stakeholder management should not be underestimated and at any given point during the project prioritized. Especially internal stakeholder management should not be ignored but more actively approached. (5) To build a viable solution, a problem must be solved. Therefore, it is important and necessary to focus on the problem understanding and validation at the very beginning without already sketching a solution.

To conclude, this paper showed how complex already a small-scaled product development project can be. Despite the complexity and fragmentation of the field, theory however can support practice and so a stronger collaboration should be encouraged.

This paper and its results have limitations. Overall, it must be mentioned that the results presented in this paper are based on the case study of the Nova Canteen App. General viability should be checked in further research steps also with other similar projects. Also, the presented learnings have been derived from the point of view of the Project Leader. Other impressions and learnings might arise from a different position within the team.

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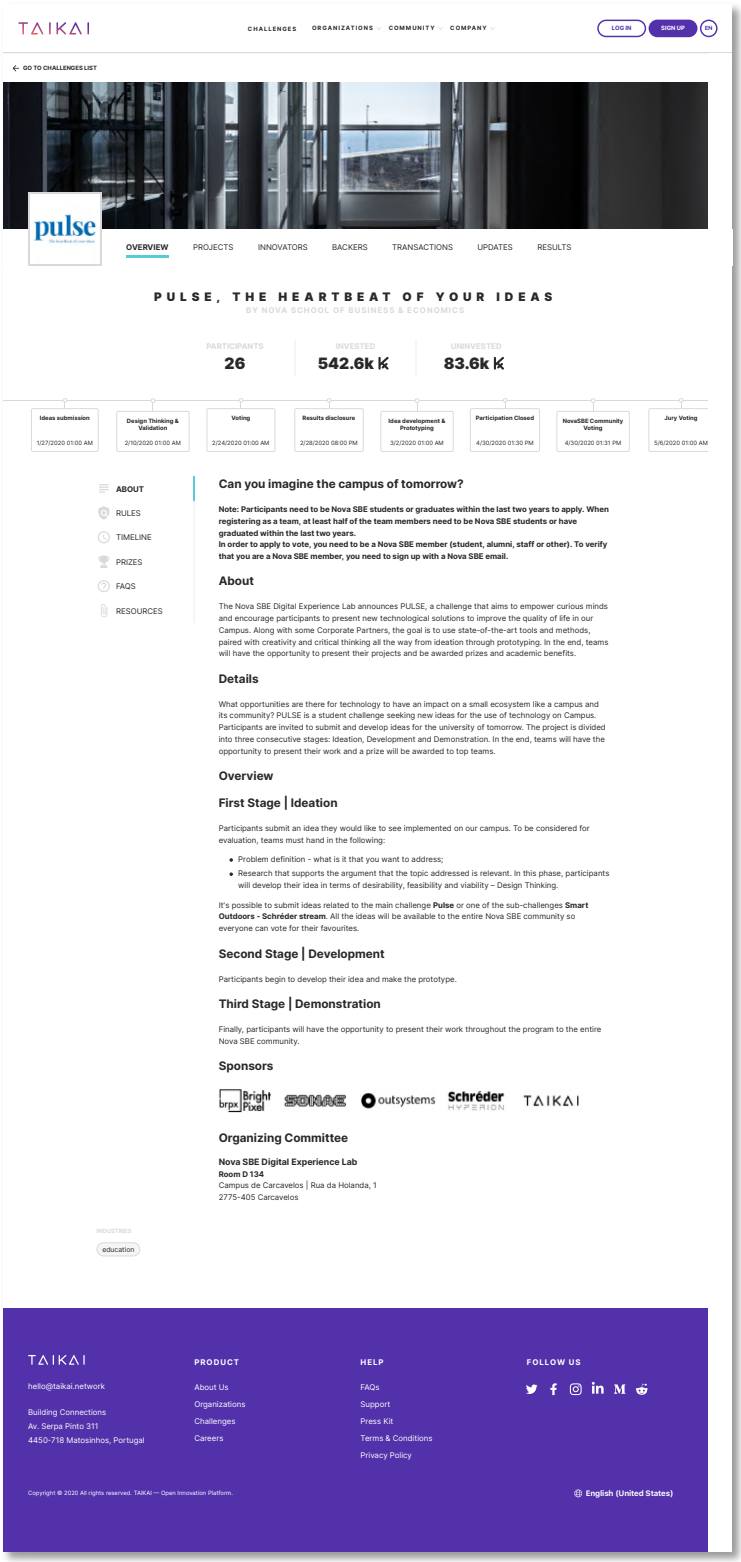
Appendixes

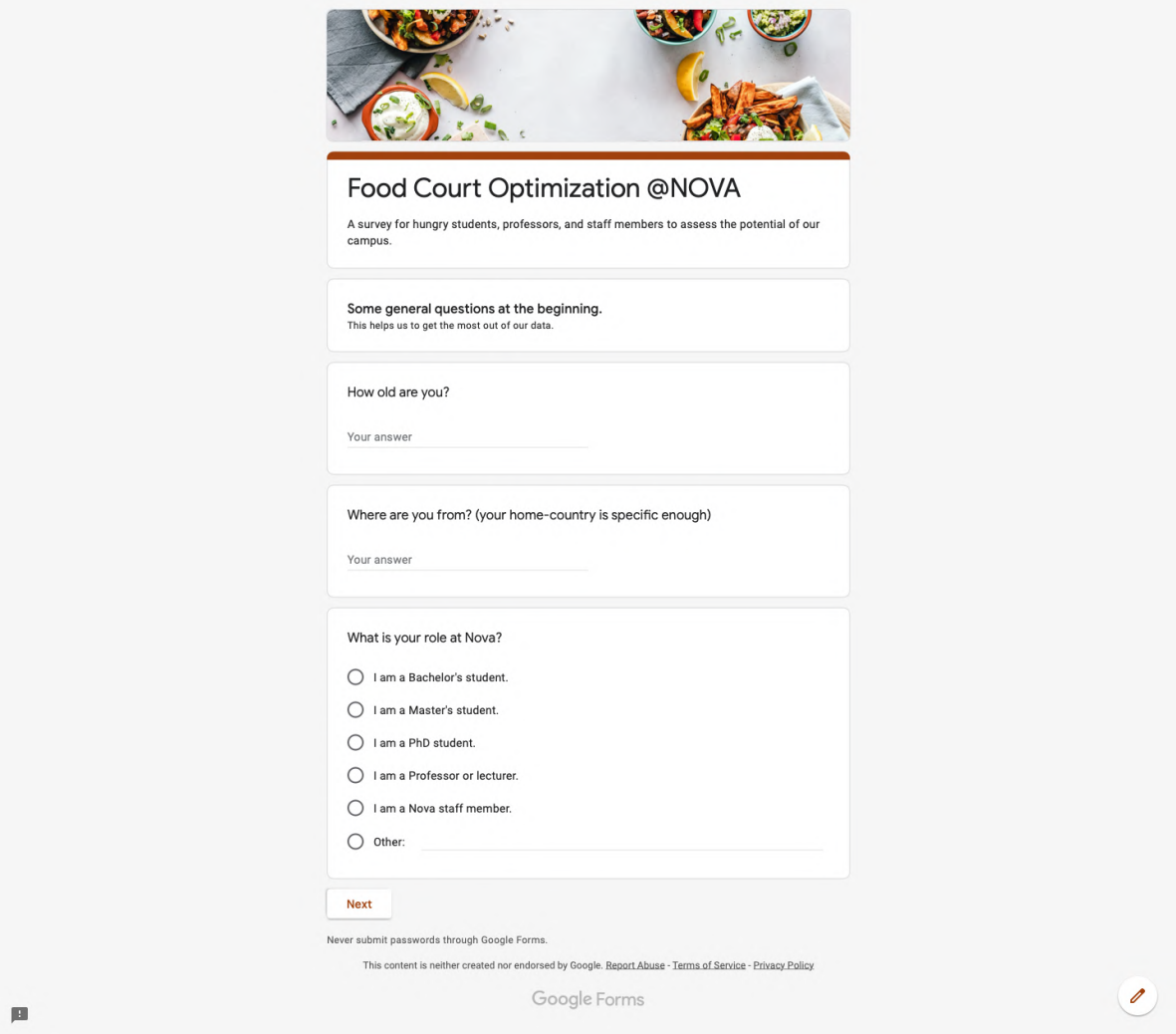
Appendix 1: Pulse Challenge Homepage on the *Taikai* Platform



Appendix 2: The Online Survey

The following Google Forms online survey was created and distributed through different channels.

Page 1



Food Court Optimization @NOVA

A survey for hungry students, professors, and staff members to assess the potential of our campus.

Some general questions at the beginning.
This helps us to get the most out of our data.

How old are you?

Your answer

Where are you from? (your home-country is specific enough)

Your answer

What is your role at Nova?

- I am a Bachelor's student.
- I am a Master's student.
- I am a PhD student.
- I am a Professor or lecturer.
- I am a Nova staff member.
- Other:

Next

Never submit passwords through Google Forms.

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Google Forms

Page 2

Food Court Optimization @NOVA

Let's explore your food behaviour.

How regularly do you eat on campus? (Proper Lunch or Dinner - no snacks included)

- ○ once per week
- ○ 2 times per week
- ○ 3 times per week
- ○ 4 times per week
- ○ 5 times per week
- ○ more than 5 times per week
- ○ Other: _____

Do you prepare your food and bring it from home or do your buy lunch/dinner/snack on campus?

- ○ I always buy my food on campus.
- ○ I usually buy my food on campus but also sometimes bring food from home.
- ○ I usually prepare food and bring it with me but also sometimes buy lunch on campus.
- ○ My lunch is always prepared food from home.

Have you tried all "restaurants" on campus?

- ○ Yes
- ○ No

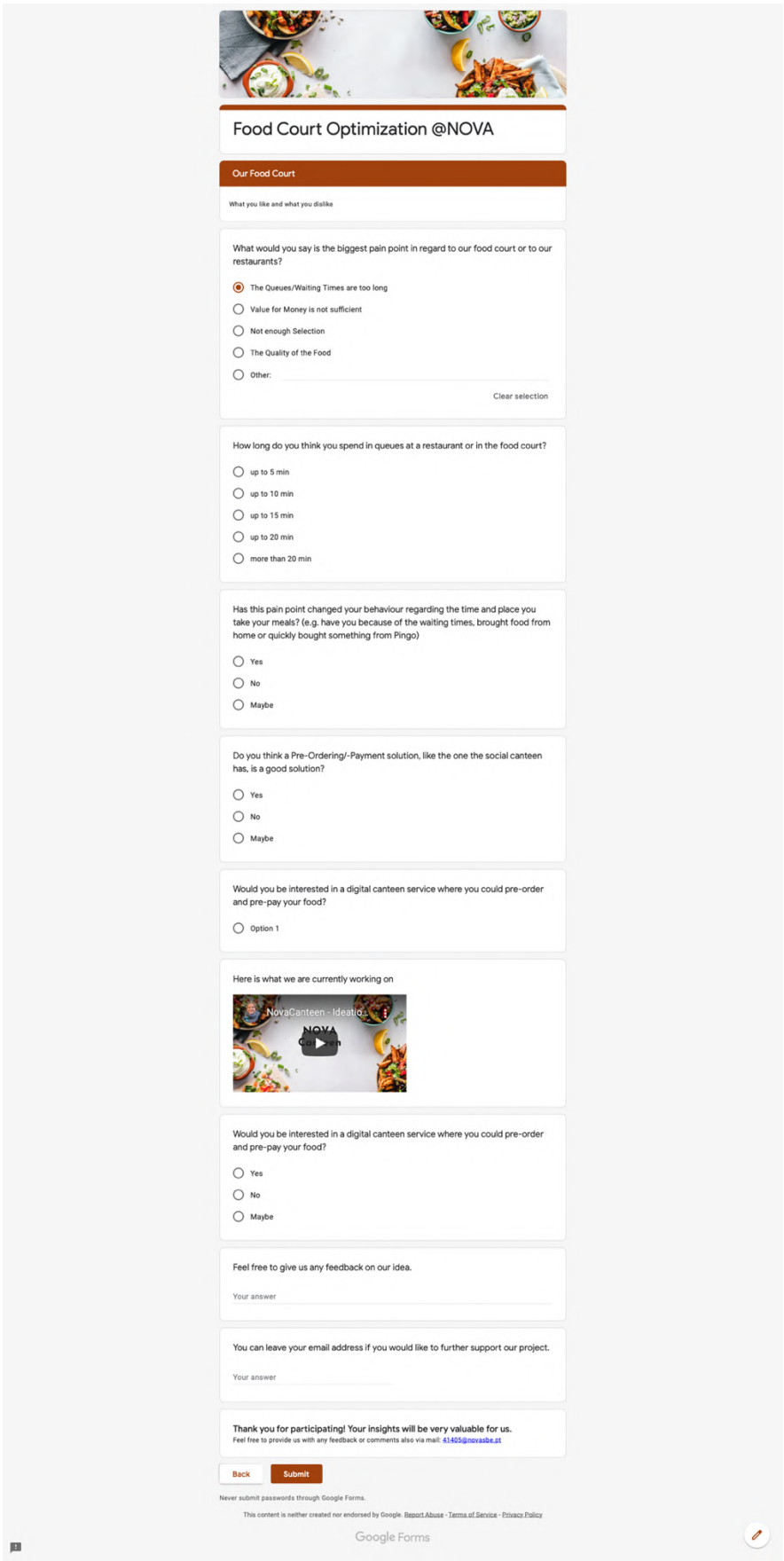
What is your favourite "restaurant"?

- ○ The Cut
- ○ The Social Canteen
- ○ Pingo Doce
- ○ Vincente Na Linha
- ○ Padaria
- ○ Other: _____

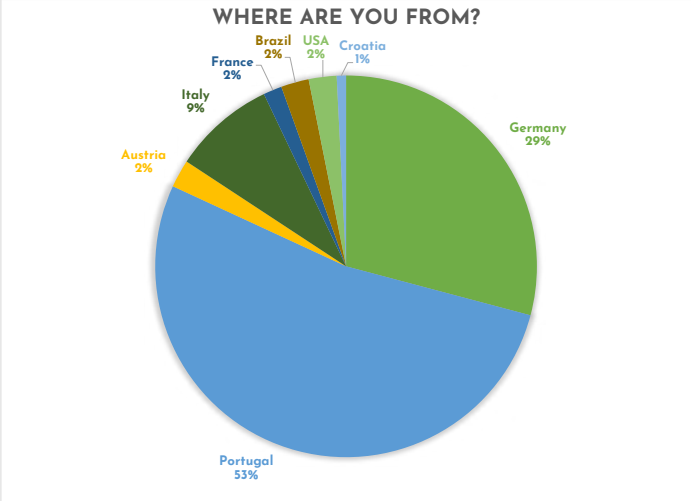
Back Next

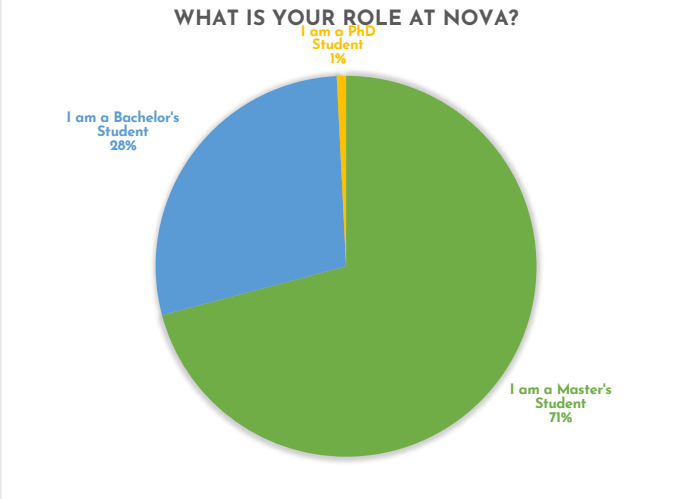
Never submit passwords through Google Forms.

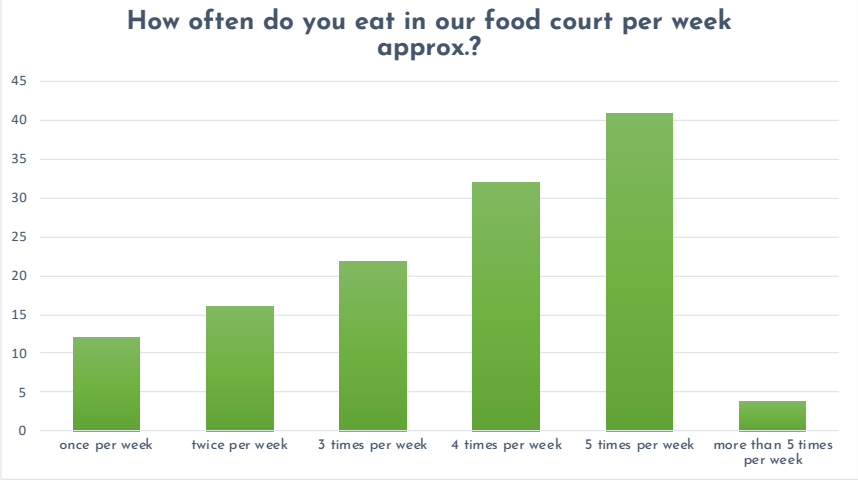
Page 3:
This final page was displayed when the option "The Queues/Waiting Times are too long" was selected.

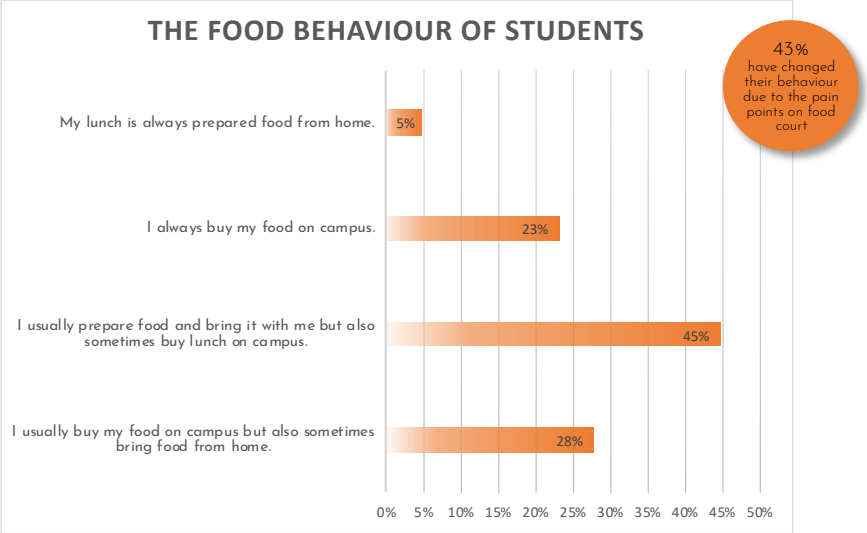


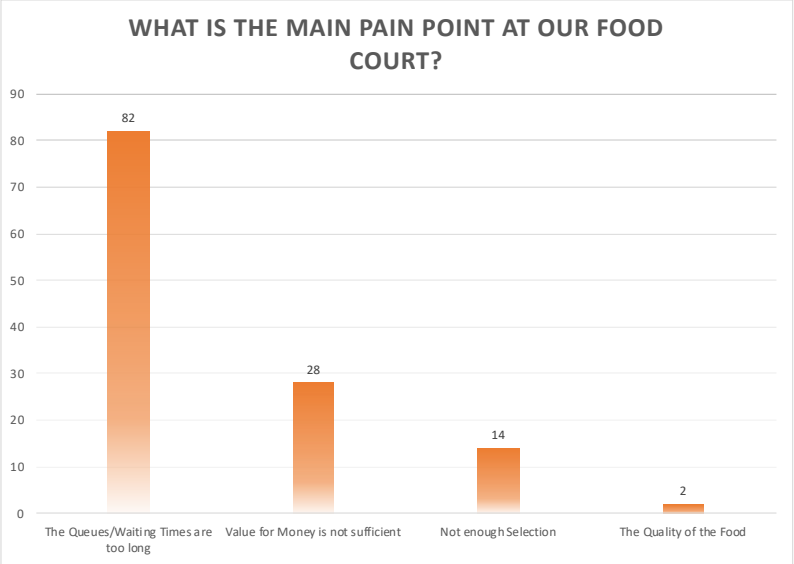
Appendix 3: The Results of the Online Survey
n=127








THE FOOD BEHAVIOUR OF STUDENTS
43%
have changed their behaviour due to the pain points on food court
My lunch is always prepared food from home.
5%
I always buy my food on campus.
23%
I usually prepare food and bring it with me but also sometimes buy lunch on campus.
45%
I usually buy my food on campus but also sometimes bring food from home.
28%
0% 5% 10% 15% 20% 25% 30% 35% 40% 45% 50%


WHAT IS THE MAIN PAIN POINT AT OUR FOOD COURT?
90
80
70
60
50
40
30
20
10
0
82
28
14
2
The Queues/Waiting Times are too long
Value for Money is not sufficient
Not enough Selection
The Quality of the Food

Nova Canteen - Problem Validation

MASTERS STUDENTS

MSC STUDENTS (interview in English or German)

Q	XXX	XXX	XXX	XXX	XXX	XXX
Age	24	24	23	22	25	26
Master/Bachelor	Master	Master	Master	Master	Master	Master
International/National	International (German)	International (German)	International (German)	National (Portuguese)	International (German)	International (German)
1. How regularly do you eat at uni? /at a restaurant at uni? What does your eating behaviour on campus look like? Do you prepare food?	"I am on campus usually 3-4 times a week and always have at least lunch on campus. My classes usually always end at 12:30 and we directly have lunch afterwards."	"Always when I am on campus, I also eat there. When I know that I will be on campus all day, I have prepared food in advance."	"I always eat on campus! I know a lot that prepare their food but I dont do that. So, I usually go with the food on campus."	"I always eat on campus. But I usually dont try the restaurants. I live at home and usually bring food. But it did happen also from time to time that I forgot my food and had to buy something. Then the queues are really long."	"I eat on campus usually. Sometimes also in the restaurants nearby when I want to try out something new with some friends. The problem is, I think, that the prices are sometimes too high. The restaurants do not really have a great offering but I am still happy they are there!"	"I dont prepare food. I usually eat on campus. With the new Pingo Doce, I have started to eat snacks and lunch from there but the selection is a bit limited so that I have already started to switch again to the canteen from time to time. The queues are though really annoying."
2. Have you tried all restaurants on campus?	"Yes! My favorites are the social canteen and Pingo!"	"No- I havent been to all of them"	No	No	Yes	Yes
3. If you have lunch/dinner at NOVA, where do you usually eat? Where do you order? And why? Why not somewhere else?	Social Canteen or Pingo - the others are sometimes too expensive	It varies. But usually Social Canteen and Pingo - and sometimes the pizza place.	I like the bakery and have a quick breakfast with friends there sometimes. For Lunch, its social canteen and the burger place.	Usually Pingo for Snacks	I like the burger place and the pizzas and Pingo actually. I also go to the bakery, I guess even everyday.	We usually end up at the social canteen. But I also like the burger and pizza place.
4. Please rank the following attributes according to their impact on the decision on where to eat: Price, Nutrition, Waiting Time, My Friends Choice ... other	1- price 2-waiting time 3- food they offer 4- my friends choice	1- waiting time 2- price 3- nutrition 4-my friends choice	1- nutrition 2- price 3- waiting time 4-my friends choice	1- price 2-waiting time 3- food they offer 4- my friends choice	1- taste 2- my friends choice 3- waiting time 4- price 5-nutrition	1- my friends choice 2-price 3-waiting time 4-nutrition
5. What would you say is for you a big pain point in the food court at the moment?	"It can take ages to get your food. I dont know what the problem is. Perhaps , there is not enough offering but I think there is. Perhaps there are not enough people working there? That could be the problem."	"It is really hard to time your lunch or snack from time to time. You never really know how long it might take and sometimes I only have limited time. That is usually annoying so that I sometimes eat to odd times."	"The queues are sometimes really long. The bakery in the morning for example is really a problem in my opinion. I usually cannot really think when I havent had breakfast but it is impossible to be on time while getting something in the morning. Big problem is also if you were planning to have lunch or so with friends. That will never work out. One is finished while the other hasnt even had his food yet. "	"It is really too crowded sometimes. If it is raining and also everyone eats inside also the seating is sometimes not enough. If you want to get a snack, you would go to Pingo but it is super crowded so I usually avoid that."	"I think sometimes the food experience is a little limited on campus. It is really just a quick, fast food. Everything is so hectic and you never know whether you will make it to class afterwards."	"Its really stressfull to manage a food break with friends. We used to get food from the canteen or so but now we often get a snack from Pingo and go to the Beach. I get hungry super quickly though. But the process of food ordering with friends really takes ages. The queues are horrible during lunch."
6. What would you say is the reason for this pain point?	*see above*	"Well, I guess it might have to do with the general scheduling of everyone on campus. Everyone wants to eat ca at the same time. It would be quiet interesting to see whether this would still happen if the schedules differ perhaps. Because on some days, the crowd is rather small in our food court as well."	"The bistros, cafes and restaurants are sometimes not really prepared for these peaks in the morning and duringh lunch, I feel."	"Too many people wanting to eat at exactly the same time. The time schedule might be a thing,"	It is super crowded	The queues are too long. The restaurants have only one cashier there even during peak hours.
7. Has the current situation also infected your behaviour? Have you decided to eat at a later time or skipped a meal or just went to Pingo because it is quicker?	"I know quiet a few other students that have started to bring their own food. Not only due to the prices but also becuase the waititng time is too long"	"Yes, I ate at add times then more in the afternoon or bought a snack early to have it then for lunch"	"I started to make breakfast now and sometimes really bring food from home just to be sure"	"Yes, I was once thinking to perhaps eat on campus but I decided not to now."	We started to go to restaurants also outside of the campus.	*See above*
8. How long would you say do you wait usually in a queue when waiting for food at NOVA?	10-20 min when it is really crowded	It depends. I guess someting from 2 min to 15 min?	Well, in the morning it can be up to 20 min, I guess	-	10-25 mintes definetly	at least 10 min, I would say. And that can be a lot when you have classes or want to go to the beach.

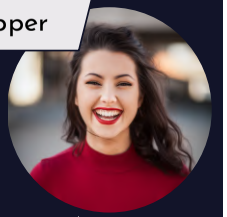
BSC STUDENTS (Interview in English or Portuguese)

Q	XXX	XXX	XXX	XXX	XXX
Age	18	19	21	18	21
Master/Bachelor	Bachelor	Bachelor	Bachelor	Bachelor	Bachelor
International/National	National (Portuguese)	National (Portuguese)	National (Portuguese)	National (Portuguese)	National (Portuguese)
1. How regularly do you eat at uni? /at a restaurant at uni? What does your eating behaviour on campus look like? Do you prepare food?	I eat at uni but bring my food. Sometimes I get snacks on campus.	I bring my food for lunch. Breakfast or snacks though, I buy on campus.	I bring my food usually but sometimes also get something or also a full lunch at uni as well.	I bring my lunch from home	I eat on campus. Most of the time, I have brought food from home. But I usually end up at Pingo at least once a day.
2. Have you tried all restaurants on campus?	No	No	Yes	No	No
3. If you have lunch/dinner at NOVA, where do you usually eat? Where do you order? And why? Why not somewhere else?	I eat in the foodcourt and meet with friends. If I want to order something then usually from the burger place. For snacks, I go to Pingo.	I eat with friends, preferably outside. Some order something from the food court and we eat together then afterwards if possible. The foodcourt is sometimmes too crowded and hectic	I usually bring food so that I dont have to order anything but if I do, then it is usually the social canteen or the pizza place.	I eat with friends in the food court or outside. Sometimes also at the beach. But we need the microwaves.	I eat in the food court with friends. Everyone usually brings there food but it is really crowded sometimes due to the queues everywhere.
4. Please rank the following attributes according to their impact on the decision on where to eat: Price, Nutrition, Waiting Time, My Friends Choice ... other	1- waiting time 2- price 3- nutrition -4 friends choice	1- price 2-waiting time 3- food they offer 4- my friends choice	1- price 2-waiting time 3- my friends choice 4- nutrition	1- nutrition 2-waiting time 3- price 4- my friends choice	1- waiting time 2-price 3- my friends choice 4-nutrition
5. What would you say is for you a big pain point in the food court at the moment?	The food court gets really crowded. Some people get super annoyed from the long queues so that we usually try to bring our food from home. If one hasnt, he/she usually comes then super late when we were actually already about to leave again.	The queues for breakfast in the morning before class are super long. They sometimes even stand outside of the cafe. If I see it from the far, I directly go to Pingo instead, even though I really like the bakery.	The queues can be really long. You then get your food really late and have to hurry while eating. Something from the docial canteen or also a burger - you cannot really eat it that fast and usuually also cannot get it as a takeaway.	The queues at the microwaves are sometimes annoying. It in general gets super crowded in the foodcourt during lunch.	The queues really annoy me sometimes. Especially during lunch it is really crazy sometimes.
6. What would you say is the reason for this pain point?	The offerings are perhaps too little. Or the processing times are too long.	Perhaps they have too little cashiers or are not quick enough.	Everyone is hungry at 12:30 and comes out of class. Before that it is realtively calm.	Everyone wants to eat at the same time and is usually in a hurry.	Most of the studenst dont prepare the food. The restaurants also seem to not manage the crowds too well. But they also come all at once usually
7. Has the current situation also infected your behaviour? Have you decided to eat at a later time or skipped a meal or just went to Pingo because it is quicker?	I usually go to Pingo beause it is easy and conveneint. I guess I wouldnt have bought the snacks I buy without Pingos.	*see above*	I usually go for the smalles queues and sometimes do not even care about the food selection.	I usually sprint a little after class to be quickly at the mcirowaves.	Not really.
8. How long would you say do you wait usually in a queue when waiting for food at NOVA?	I dont know personally. But I have heard from really long waiting times.	I usually avoid longer queues. But I guess you can easly be at 10 min.	It can be very long. I guess ca. 15 min of standing in queue. The preparation is then also another thing.	At the microwaves, I can be up to 10 min, I guess.	it feels really long

THE PROBLEM

Our Personas

The Food Prepper



Name: Barbara Coimbra
Role: Bachelor's Student
Age: 19
Nationality: Portuguese

Food Behaviour: Barbara still lives at home and brings prepared food to university almost every day. She uses the food court mainly for snacks between classes. Her go-to snack supplier is Pingo.

Spends on food per month: ca. 25€

Main Pain Point: The long queues of others also influence her experience. If Pingo is too crowded, she is probably not going to buy anything.

The Social Eater

Name: Stefan Bavaria
Role: Int Master's Student
Age: 25
Nationality: German

Food Behaviour: Stefan comes to uni without food for lunch or dinner. He lunches with his friends and usually goes for the cheapest (end of the month) or most nutritious (start of the month) food options in the food court.

Spends on food per month: ca.100-160€

Main Pain Point: Especially when lunching with friends that have different food preferences, he usually lunches alone, as they have wait longer or shorter in their queues.

The Foody

Name: Pepe Toscana
Role: Int Master's Student
Age: 23
Nationality: Italian

Food Behaviour: Pepe enjoys good food. He is open to try new meals but also regularly brings already prepared food to uni as he has allergies.

Spends on food per month: ca 60-120€

Main Pain Point: Often when Pepe is in food court without prepared food, he regrets it due to the lack of selection or quality. Or also the other way around. He would love to already know beforehand what is offered so that he can come prepared.

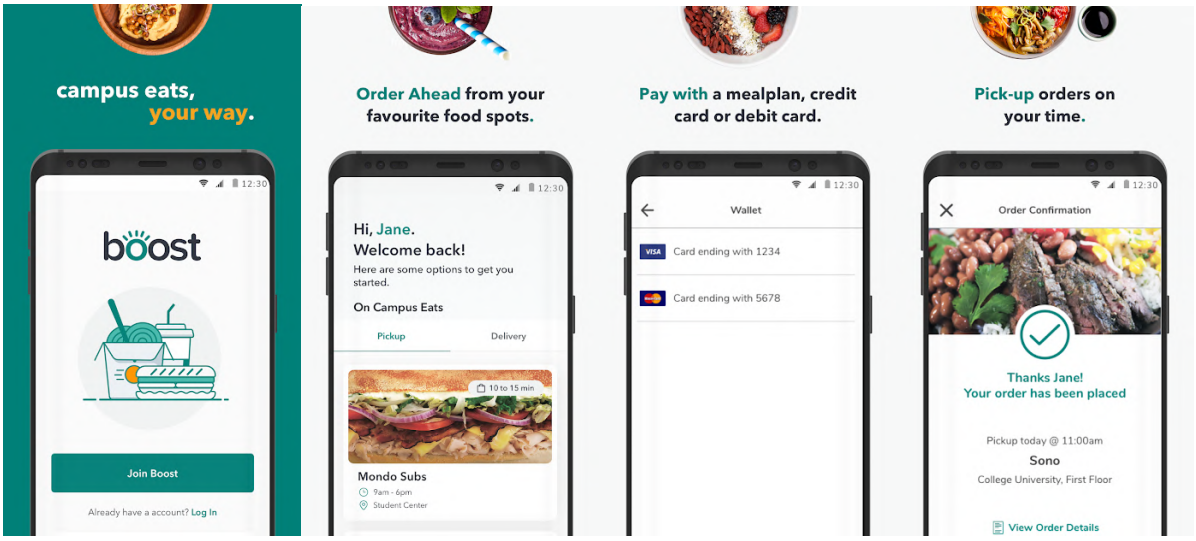
Appendix 6: The *boost* Mobile Ordering App from the University of Houston

boost

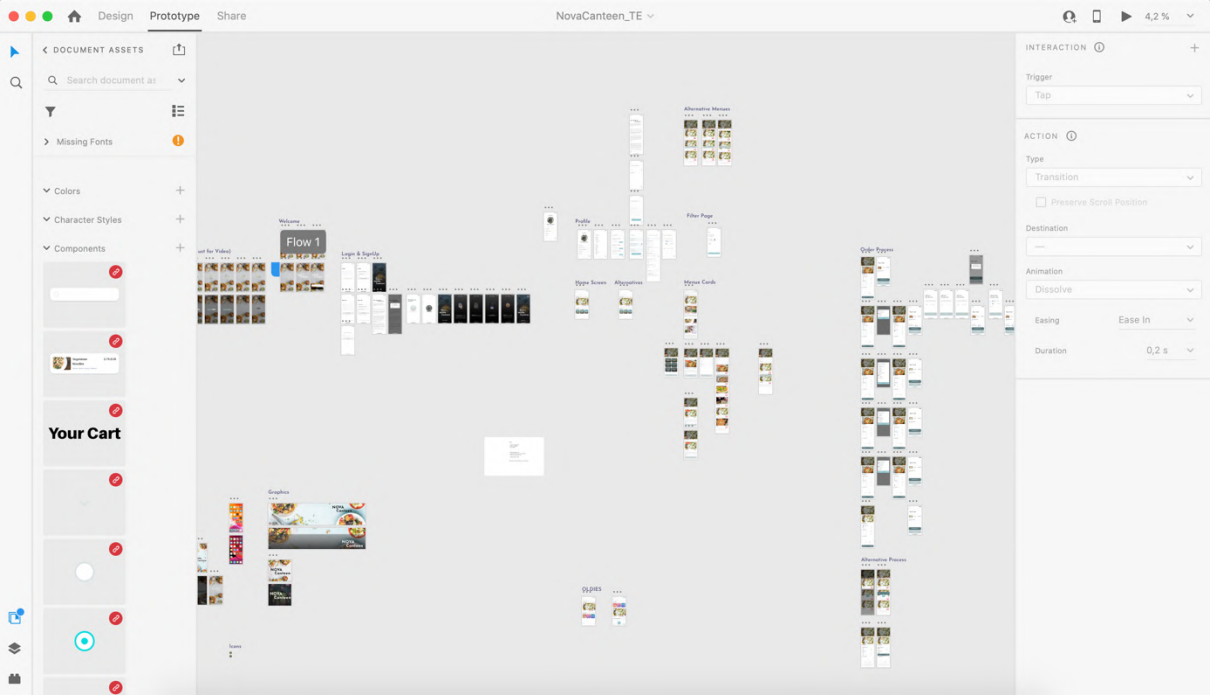
campus eats,
your way.

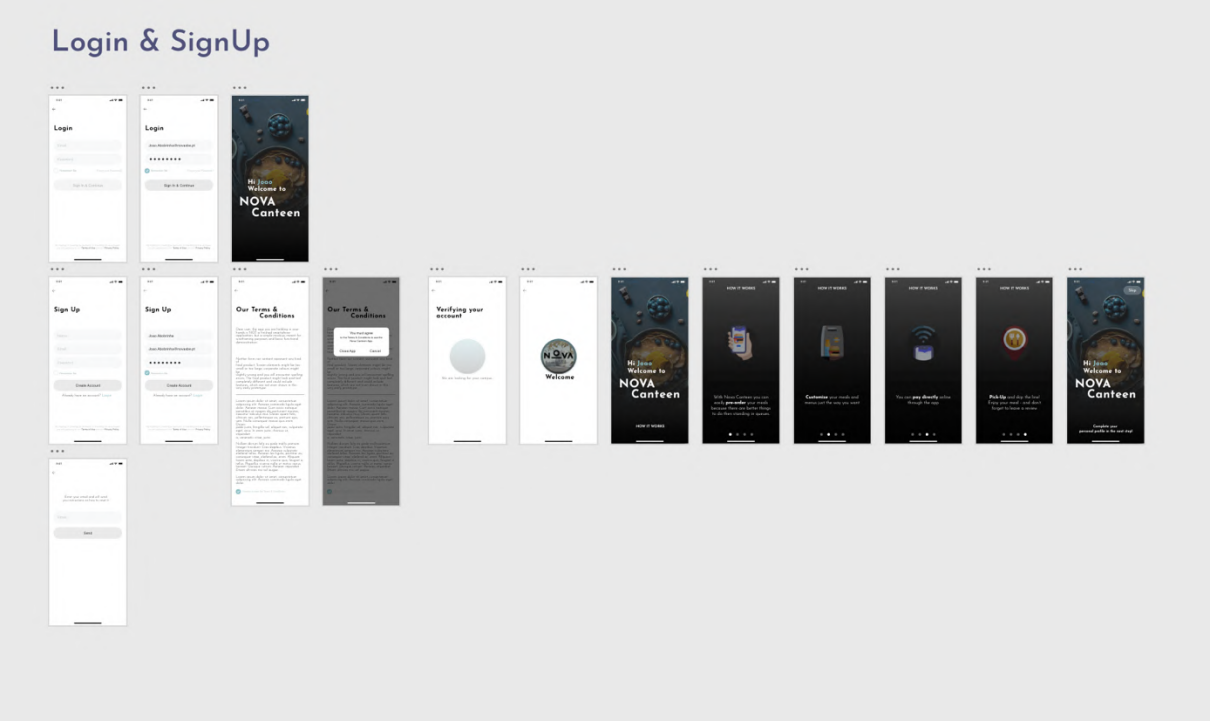
skip the line all over campus with
boost mobile ordering
- **download now**

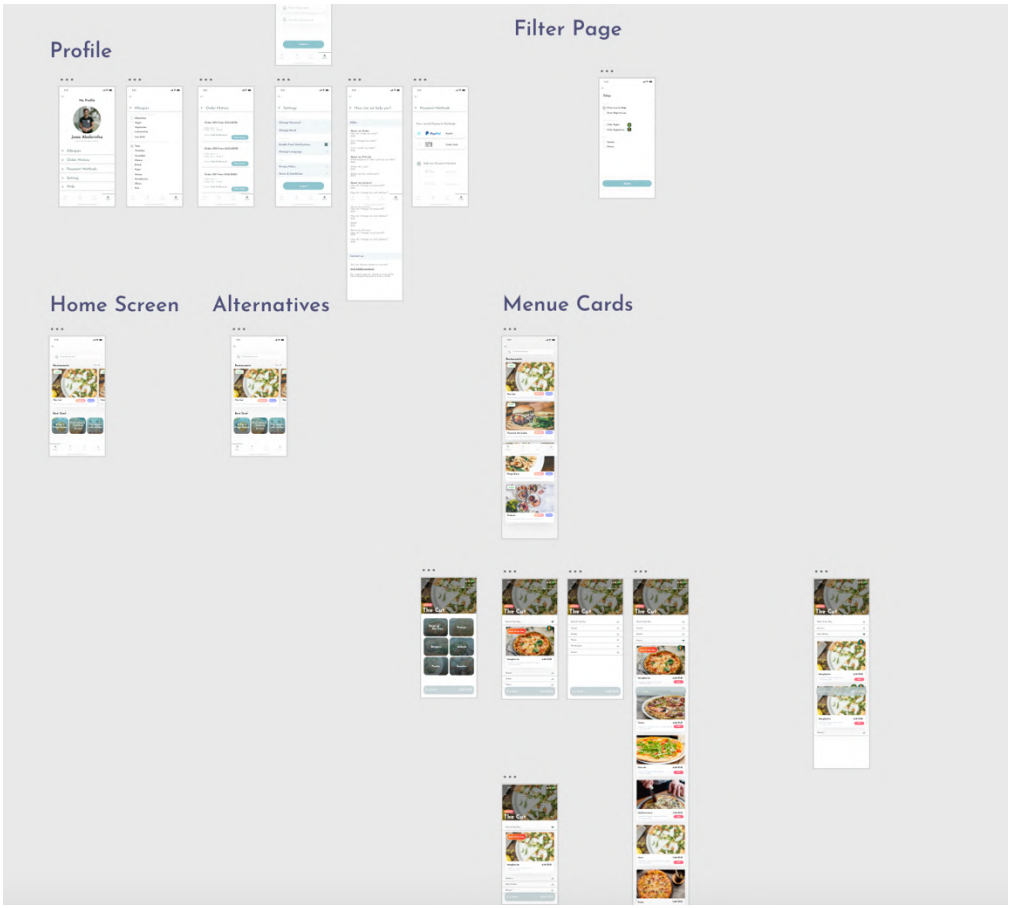
GET IT ON Google Play Download on the App Store

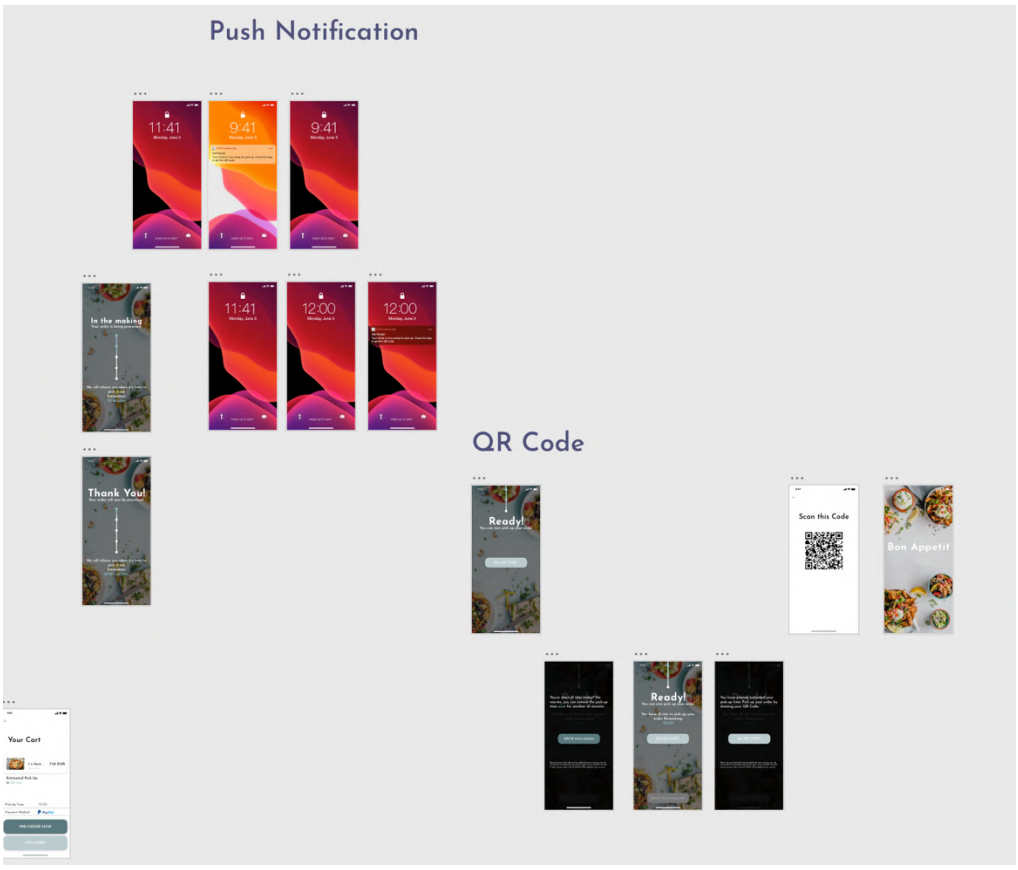


Appendix 7: The Nova Canteen Design Prototype Flow

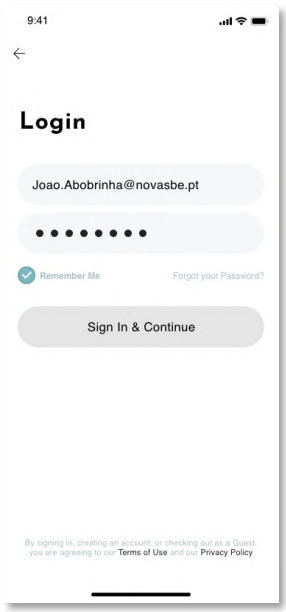


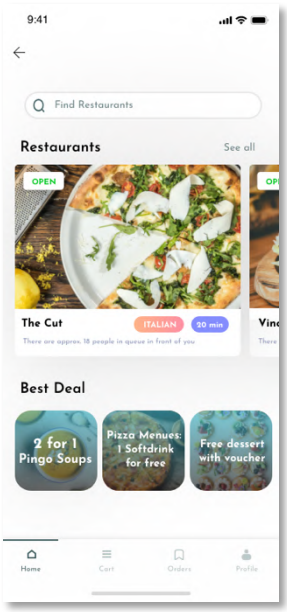


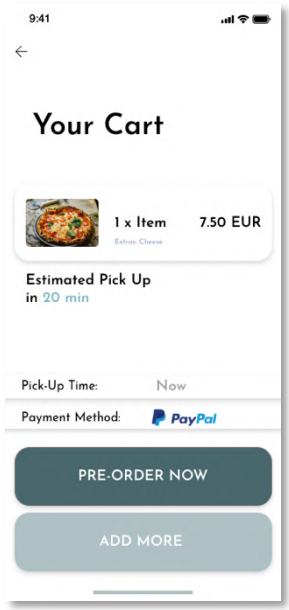

Profile
Filter Page
Home Screen
Alternatives
Menue Cards

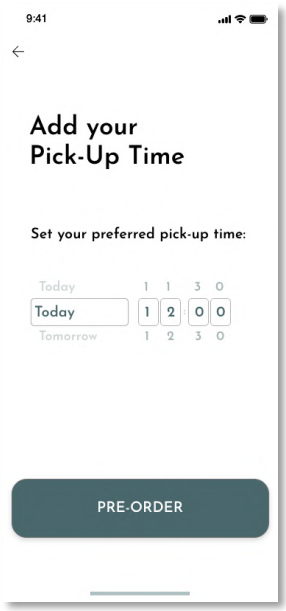

Push Notification
11:41
9:41
9:41
In the making
11:41
12:00
12:00
Thank You!
QR Code
Ready!
Scan this Code
Bon Appetit
Your Cart
Ready!

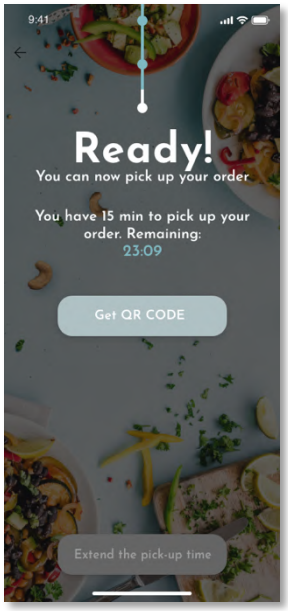
Appendix 8: Prototype Design for User Interface (Ordering)



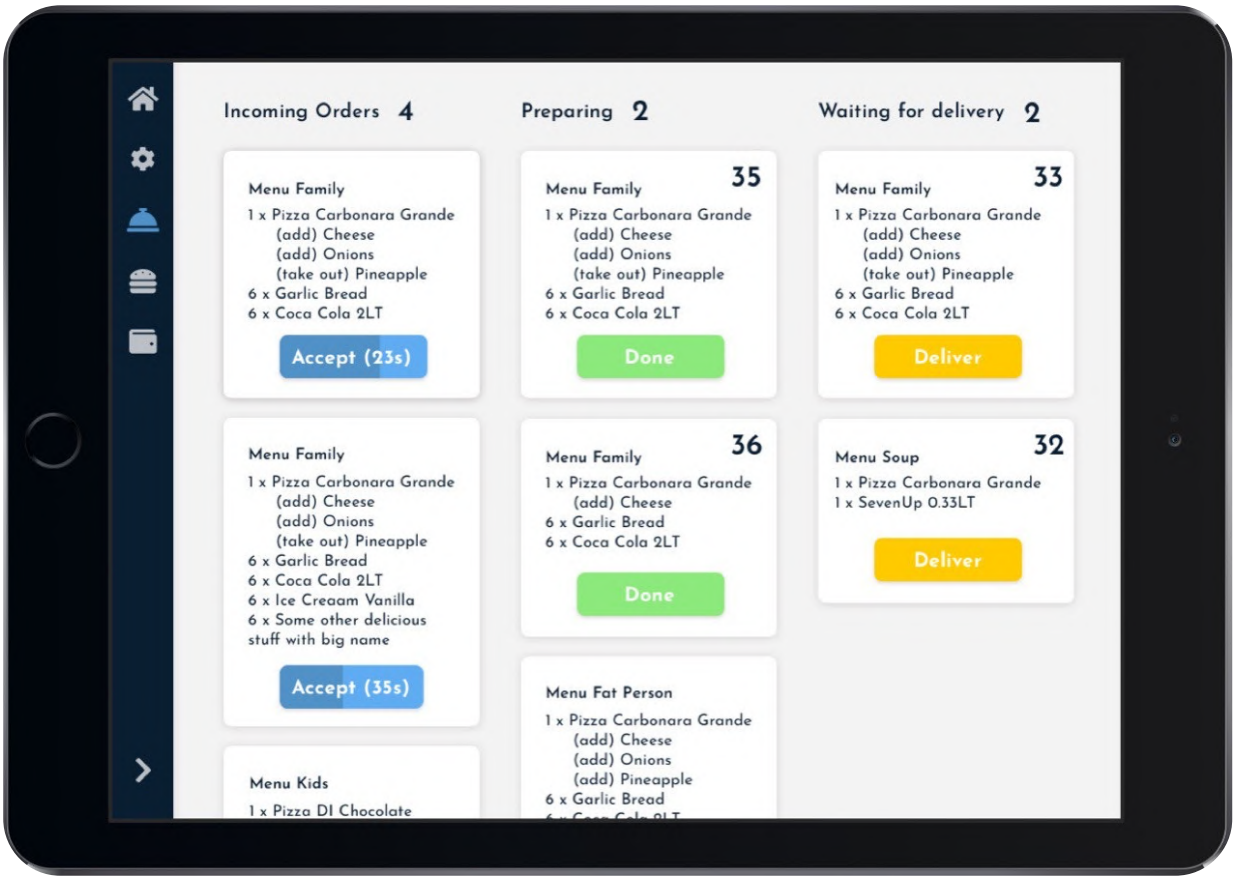




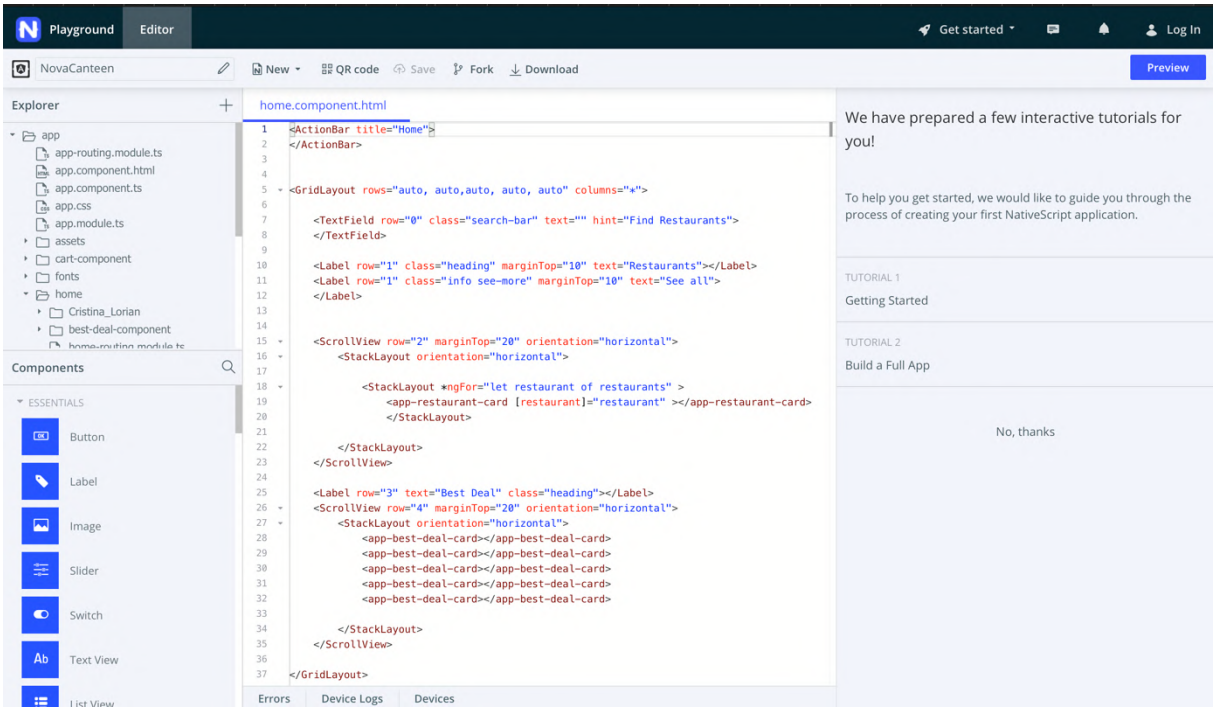




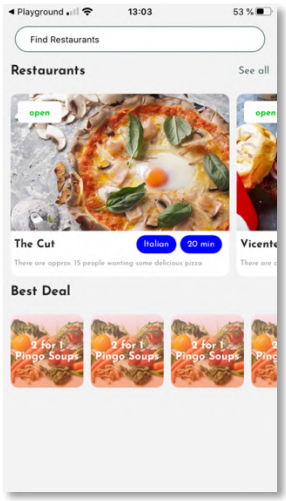
Appendix 9: Prototype Design of Restaurant Interface (Receiving Order)

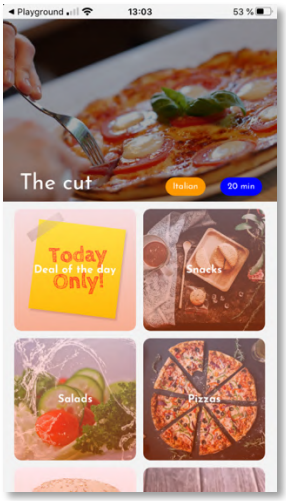


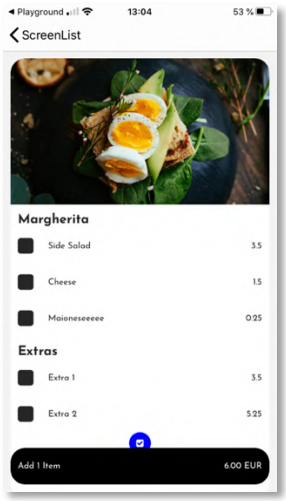
Appendix 10: Native Script & Coded Screens



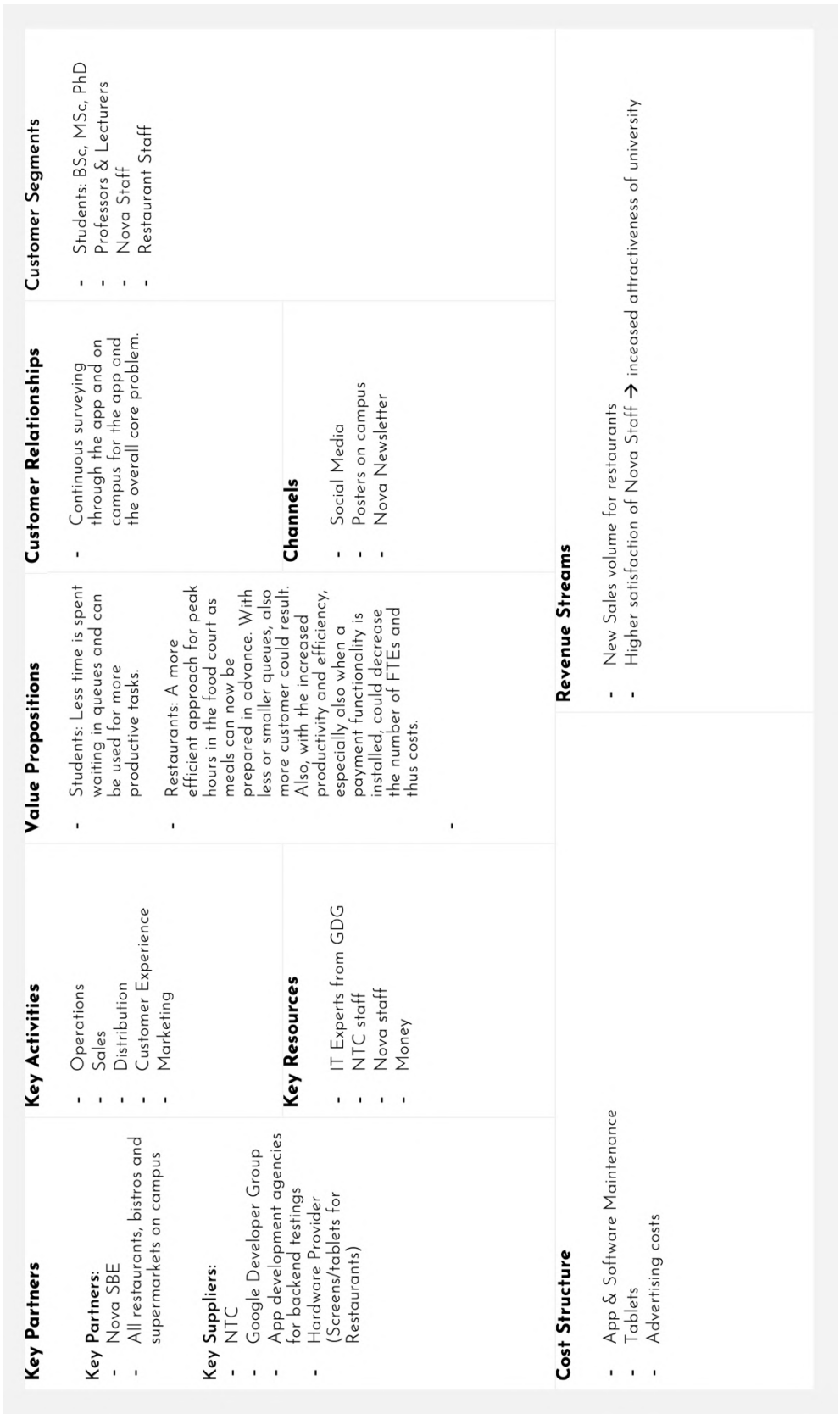
The coded end-user screens:



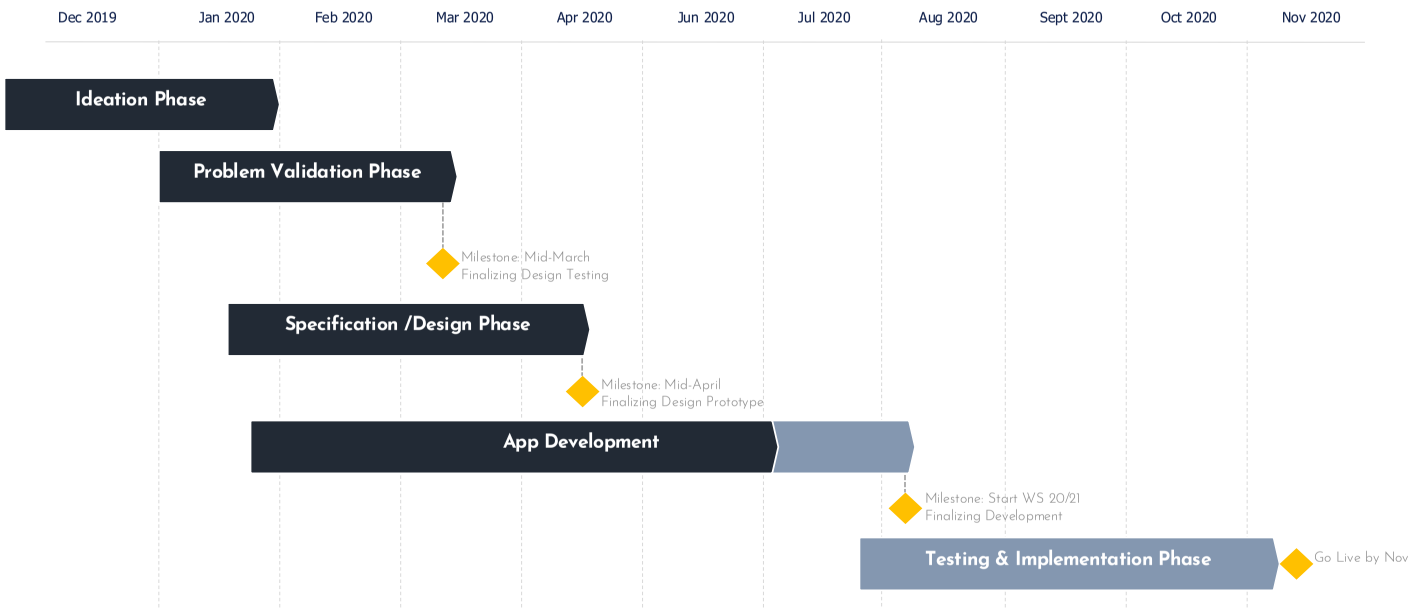




Appendix 11: Nova Canteen Business Model Canvas & Project Plan



The Project Plan



Appendix 12: Pulse Challenge – White Paper Nova Canteen App

1. Introduction

The Nova Canteen App is designed to support the hungry student. At NOVA we have several delicious lunch, dinner or break spots that offer fresh and nutritious food - but with many students come long queues. This is where we come in: With the **NOVA Canteen App**, students can easily pre-order their meals while spending their waiting time in more productive environments (library, class or group meeting). With this report, a more detailed introduction into the project will be presented.

2. The Problem: Identification and Validation

This project is the result of a brainstorming session within our project team from the Nova Tech Club. The initial idea was to brainstorm problems on campus for which applications could become ideal solutions. Inefficiencies in the food court like long waiting lines was one of the first problems raised. With loud and passionate reactions from our group, we quickly agreed to start tackling this identified problem.

2.1 The Survey

To validate this pain point, we needed data. Our strategy for this was to start on online survey to obtain an impression of the common mood, while subsequently also conducting direct interviews to get more detailed insights of the problem, the needs and the general behaviour in the food court. Over 125 current bachelor's, master's and PhD Nova students from eight different countries answered our online survey (see *Appendix 1* for more information and graphs). According to our results, the typical student is at least five times per week at the food court actively buying a meal or a snack. The analysis shows that more than half of the students at least "usually" if not even "always" buy their food at Nova instead of preparing it at home. So, the importance of offering healthy food as well as a healthy environment is crucial. While only two (1,6%) of all responses criticized the quality of the food, 65% of the students see the long waiting times or queues as the main pain point in the food court. 43% even said that due to this, they have changed their usual food behaviour to either bring prepared food from home or to go for a quick and perhaps even less nutritious alternative instead, just to avoid the lines. So, we stopped the clock. According to three individual measurements, the waiting time can be up to 20 min during lunch time. So, while the food court is already offering nutritious and fresh food, it seems to fail at offering the needed environment to actually also have a lunch *break*.

2.2 The Interviews

Having now validated the overall problem, we needed to further understand the actual pain point to then design the needed solution. For this, we conducted ten individual interviews with master's and bachelor's students to more freely build dialogues around the problem. The result of all interviews was that different needs led to different problems with the current food court organization. However, everyone saw the inefficiencies resulting in long waiting lines as the core. Our approach was now to create personas according to their pain points and needs. The ideal objective was then to find a solution suiting all. The first persona was described as the "Food-Prepper". Someone who typically brings food from home but uses the food court to buy snacks. These persons usually go to Pingo Doce and are annoyed by the overcrowded shop especially at the pasta and pizza bar. The second persona is the "Social Eater". Someone who plans their food breaks according to their friends. This group seemed to be the dominating one as they are more directly influenced by the problem, as they are actively standing in line. Usually, they all select one restaurant as otherwise the waiting time differences interfere with their actual meeting plans. The third persona is the "Foodie". Someone who loves food more than he hates standing in line. While the frustration of the queues is as high as for the social eater, this persona still values the options given very much. More transparency and customization would improve his customer experience.

Nevertheless, the resulting insights only covered one half of our stakeholder groups. As our solution would mean becoming an intermediate between the user and the restaurants, of course also the restaurant's view on the topic was highly relevant for us. Despite best efforts, we were due to the COVID-crisis not able to get a direct response from any of the restaurants at Nova's food court. However, during our benchmark analysis we reached out to all similar solutions to use other's insights representatively. We were very happy to get a response from Mrs Alexcis Mendoza, Marketing Manager for UH Dining at the University of Houston, Texas. In 2017, they successfully implemented an on-campus mobile ordering app called "boost" (see *Appendix 2* for more information). She very briefly explained that our identified problem is also very close to the one observed on their campus. Their results show that nearly all restaurants saw an added value in the app and joined the platform very quickly. We are still waiting on further insights regarding their business and cooperation model as with boost, they teamed up with an external provider.

3. The Solution: Design & Development

In the course of our project, we started developing a team structure according to our new objective. With the network of the Nova Tech Club, we were able to get the technical support of Pavlo Figol, a Google Developer Group (GDG) software developer specialized in app development. With his help, we now aimed to actually build an MVP of the app to demonstrate it live during the Pulse final presentation. For this, we split the group partially in two: One team focussed on building the app design which will function as the specification of the app screens while the other team focussed on coding the screens according to the design. We scheduled weekly or bi-weekly sessions to improve the coordination and cooperation between the teams. Pavlo helped us along the way in a support and teaching role for which we are very thankful for.

3.1 The Design

We already started designing potential processes early on in our project. An initial design idea was created after first results from the survey and our interviews were analysed. The main idea was to keep it as simple as possible and to follow already existing pre-ordering app models to make the handling also as convenient as possible. The general customer journey is therefore constructed very similarly. After registering in the app with the university mail address an individual account is created which is directly linked to the university's main account. This architectural design is meant to offer scalability as this app could also be introduced on other campuses as well. The individual registration is complete after adding a payment method. The user can then enter the home screen on which all local restaurants are listed (see *Appendix 3* for the screen designs). The app can be used to either pre-order meals in advance for the next day or to pre-order immediately. For this, dynamic information regarding the current waiting time is displayed. On the basis of historical data as well as a smart backend system on the restaurant side, the app can calculate dynamically the approximate waiting time and potential queue position. The general order process is similar to other ordering processes where first a meal is selected, followed by a possible customization, to then set a pick-up time and pre-pay the meal. A push-notification signals that the pick-up is ready.

Next to the end user application, we also worked on the restaurant interface with an even simpler overall handling. Users would have only three main functionalities: accepting/refusing an incoming order, setting the order to "ready to pick-up" manually or automatically and, if needed, contacting the customer. With this, users can easily track the orders as well as their overall operations.

All screens were designed with Adobe XD. Design tests were planned but had to be moved to online communication means (due to COVID-19), which unfortunately was not as effective as idealised. New tests are planned for the upcoming weeks.

3.2 The Development

After having designed the main screens, we started coding. Using mostly Google technologies, Pavlo suggested to work according to the web application framework *angular*. For this, we started using the online platform *NativeScript* to build the app as a native iOS and Android mobile app. While some of the coding team members had already worked with front-end development, the majority was completely new to the topic so that we teamed up in pairs to allocate the resources more efficiently. The resulting screens coded in HTML and CSS were presented in our group to then gather feedback and discuss next steps. As we were actually planning to show a live demonstration of the app during the final presentation, we also worked on the restaurant interface. The development phase is still ongoing, and our team is happy to work further on our idea also during the upcoming winter semester (see *Appendix 4* for the screens).

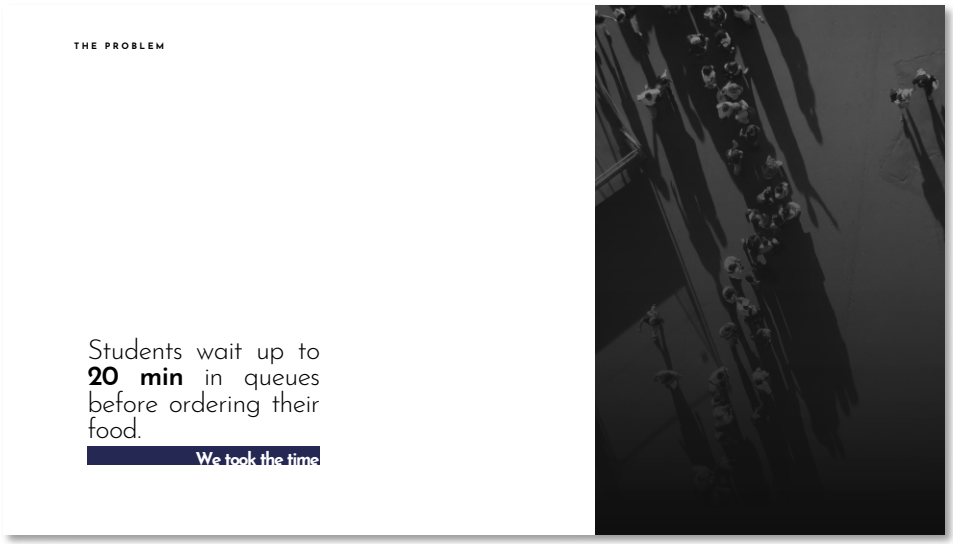
4. A Project/Business Plan: Implementation & Organisation

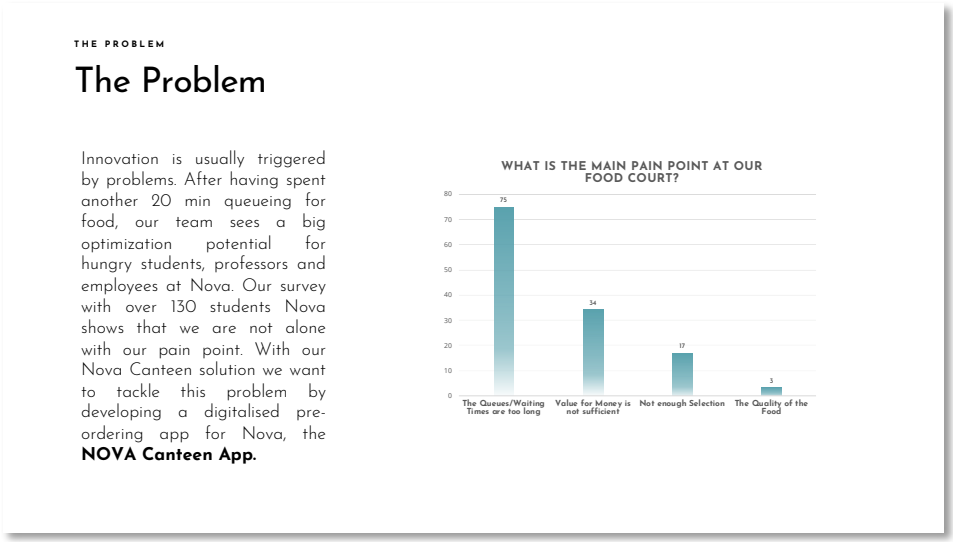
With this project we have seen that Nova has enough resources to also implement its innovation in-house. Our project team from the Nova Tech Club would be more than happy to further help in developing this app. Nevertheless, for an increased time efficiency we would recommend to also hire external resources that support in the development. Nova could decide to also use an external provider for maintenance, customer support and payment or billing. If not, further also legal instances especially for the payment process would become necessary.

The overall objective for Nova would be to improve the campus experience and not making significant profits. For the restaurants, the new channel offers new business opportunities. The result could be the need of less FTE's and a more efficiently distributed food and retail chain which will positively influence their cash flows. Costs for the development as well as the ongoing maintenance could therefore be split between Nova and the restaurants. Also, hardware devices for the restaurants would be needed to ensure a well-functioning interface to the system.

To better plan our project timeline, we developed a high-level project plan provided that until then the COVID-crisis allowed an opening of Nova's facilities and a development support is helping (see *Appendix 5*). We expect a first app demonstration to be ready after the summer break. After this, ongoing bug fixes during the testing stage would finalize a first MVP by November. So, with the underlying high scalability, further implementations could be planned from December on.

Appendix 13: Pulse Challenge - Final Presentation of the Nova Canteen App

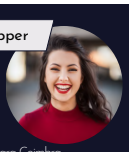




THE PROBLEM

Our Personas

The Food Prepper



Name: Barbara Coimbra
Role: Bachelor's Student
Age: 19
Nationality: Portuguese

Food Behaviour: Barbara still lives at home and brings prepared food to university almost every day. She uses the food court mainly for snacks between classes. Her go-to snack supplier is Pingo.

Spends on food per month: ca. 25€

Main Pain Point: The long queues of others also influence her experience. If Pingo is too crowded, she is probably not going to buy anything.

The Social Eater

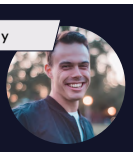
Name: Stefan Bavaria
Role: Int Master's Student
Age: 25
Nationality: German

Food Behaviour: Stefan comes to uni without food for lunch or dinner. He lunches with his friends and usually goes for the cheapest (end of the month) or most nutritious (start of the month) food options in the food court.

Spends on food per month: ca.100-160€

Main Pain Point: Especially when lunching with friends that have different food preferences, he usually lunches alone, as they have wait longer or shorter in their queues.

The Foody



Name: Pepe Toscana
Role: Int Master's Student
Age: 23
Nationality: Italian

Food Behaviour: Pepe enjoys good food. He is open to try new meals but also regularly brings already prepared food to uni as he has allergies.

Spends on food per month: ca 60-120€

Main Pain Point: Often when Pepe is in food court without prepared food, he regrets it due to the lack of selection or quality. Or also the other way around. He would love to already know beforehand what is offered so that he can come prepared.

THE SOLUTION

Let's not waste our time standing in queues...

THE SOLUTION

...save time and skip the line.

- **Pre-Order**
  Skip the line by pre-ordering your meal
- **Customize**
  Adapt your meal to your individual preferences
- **Pre-Pay**
  Link your Credit Card to pay directly online
- **Pick Up**
  ... and enjoy your food!

THE SOLUTION

Pain Points solved!

What's with Barbara?

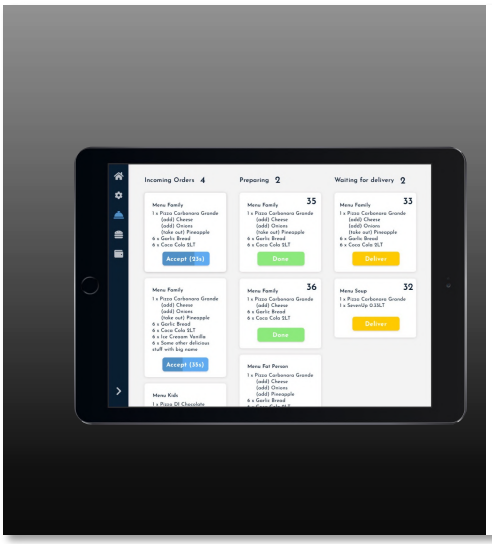
Barbara can now relax as she strolls through the aisles of Pingo. She now misses no opportunity to get her snacks, which is also benefiting Pingo.

What's with Stefan?

Stefan can now spend his more efficiently. With the Nova Canteen App he can schedule his lunch dates and has now more time with his friends (or in the library). Also, he can easily track his spending.

What's with Pepe?

Pepe can now easily plan ahead with the Nova Canteen App. He pre-orders if he likes the daily specials or prepares his own food without cravings the next day. In the app, he can easily add his allergies so that a pre-selection is shown.



New Opportunities for NOVA's Food Court

- **More Efficiency**
  Improves the planning process
- **Higher Customer Reach**
  More convenience = more customers
- **New Marketing Channel**
  Promote specials easily with the app
- **Less Stress**
  For your customers and your employees